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ABSTRACT

From 1986 to 1988 the associates of the Enhancing Secondary Science Education through Science/Technology/Society (STS) for Urban Minority Youth Project worked toward establishing guidelines for STS in secondary science. The guidelines, based on study, research, discussions, and a consensus-building process, are presented along with 12 background papers by various authors. Three main ideas emerged in the process of developing these guidelines: (1) it is critical for our society to reverse the pattern of school-related difficulties and failures among members of disadvantaged minority groups; (2) STS as a curriculum emphasis has an important and unique contribution to make to the secondary science education of urban and minority students; (3) in order for STS to make this contribution, it must be shaped to empower the learning of disadvantaged minority youngsters in urban schools, and this situation requires new role relations among teachers and school leaders, learners, and members of the urban minority communities. A formulation of a 1-year course outline for an STS course for urban and minority students is presented, as well as a review of major high school level STS curricula in light of the project guidelines. Also included is a model for infusing STS studies into urban school science curricula. (JB)

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FINAL REPORT OF THE ENHANCING SECONDARY SCIENCE EDUCATION THROUGH SCIENCE/TECHNOLOGY/SOCIETY (STS) FOR URBAN/MINORITY YOUTH

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ENHANCING SECONDARY SCIENCE THROUGH SCIENCE/TECHNOLOGY/SOCIETY (STS) EDUCATION FOR URBAN MINORITY YOUTH

FINAL REPORT OF ACTIVITIES

Duration of Project

The proposal for this project was submitted to the U.S. Department of Education in October 1985, and Penn State received notification of funding one year later. The project was formally initiated on January 1, 1987. Originally it was scheduled for a duration of eighteen months, from January 1, 1987 - June 30, 1988. On July 19, 1988 a no-cost extension of six months, until December 1988, was granted.

Preparatory Activities

In the Fall term 1985, in order to prepare this proposal, the principal investigator initiated a series of meetings at Penn State, Lincoln University, and the School District of Philadelphia to conceptualize the project and formulate an initial strategy. In addition to the principal investigator, Leonard Waks, participants at these meetings included: Judith Thomas, Chair of Education and Director, Division of Social Science, Lincoln University; Dana Flint, Director of STS at Lincoln; Donald Steinberg, Philadelphia Science Supervisor; Corrinne Caldwell, Chair of Math, Physical Sciences, and Engineering Technology, Community College of Philadelphia; Dr. James Stewart, Director of the Black Studies Program, Penn State; Dr. Peter Rubba, Director of the Center for Education in Science, Technology and Society, Penn State; Dr. Mary Dupuis, Professor of Reading Education, Penn State; Dr. Ed Fagan, Professor of English Education, Penn State, and Lawrence Young, Director of the Paul Robeson Cultural Center, Penn State. In addition to the proposal, these meetings had several direct spinoffs, including:

* Planning a session at the First National Technological Literacy Conference in Baltimore, Maryland, February 15, 1986, "Technological Literacy for Ethnic Minority Students," chaired by Dr. Flint. This session was attended by over 60 people. Scheduled for one hour and forty five minutes, the session continued for over three hours, and demonstrated strong interest in the topic.

* Publication of two concept papers: "Science/ Technology/ Society and the Empowerment of Minority Students" by Dana Flint, Bulletin of Science, Technology and Society, Volume 6, 1/2, 1986, Pp. 308-310; and "STS and Black Studies: Partnership for

Progress in the 21st Century" by James Stewart. Bulletin of Science, Technology and Society, Volume 6, 1/2, 1986, Pp. 315-318.

* Preparation of a special Issue of the S-STS Reporter, Volume 2 number 4, September 1986, with Leonard Waks as Guest Editor, on "STS and Ethnic Minority Students." This 28 page issue was distributed under a National Science Foundation grant to over 4,000 science educators throughout the United States.

Project Activities

1. Background Paper and Materials (January 1987)

In January 1987 Dr. Waks prepared a background paper summarizing project goals and objectives and important items in the literature on minority education which had appeared since the preparation of the proposal. Ms. Femmigje Pit, a doctoral student in the department of sociology at Penn State, who had extensive background in curriculum projects related to ethnic minority students, joined the project as Graduate Assistant. With the assistance of Donald Steinberg, five senior Philadelphia science teachers were selected as project consultants: Dr. Cora Turpin, Girls High School, Maria Arguello, Bartram High School; Raj Rajan, Northeast High School; William Strain and Alflorence Cheatham, Germantown High School. The background paper was distributed to all project participants.

2. Initial Drafts of Empirical and Conceptual Review Papers (January - June, 1987)

Background papers were commissioned to provide an empirical and conceptual overview of the problem of secondary science education for urban minority students. The review team, consisting of Dr. Waks, chair, Dr. Stewart, Dr. Flint, Dr. Dupuis, Dr. Fagan, Dr. Rubba and Ms. Pit met once each month to discuss the literature on minority education and prepare initial drafts of the review papers.

The First round of background papers included:

* "Black Youth in Urban Schools: Attrition, Self-Concept, and Academic Performance," Judith Thomas and Dana Flint;

* "Reading Issues in Science and STS for Urban Minority Students," Mary Dupuis;

* "Integrating STS into School Science Instruction: Salience for Inner-City Poor and Minority Learners," Peter Rubba;

* "Towards an STS-Black Studies Interface," James Stewart;

* "Work, Schools, and minority Youth Employment Problems: Implications for STS in Urban Secondary Education," Dana Flint

3. One-Day Working Group Meeting of Review Team, Science Supervisors and Senior Science Teachers (July,1987)

On July 23, 1987, the project conducted a one day working group meeting at the Lincoln University Urban Center in Philadelphia. Participants included members of the review team plus Dr. Thomas (Lincoln) and George O'Brien (University of Pittsburgh), the five teacher consultants, and science supervisors from the large urban school districts in our federal region: Donald Steinberg (Philadelphia), Doris Litman (Pittsburgh), Mary Ann Brearton (Baltimore), Mary Harbeck (Washington); Anthomy Galitsis (New York), and Ed Malin (Red Clay District, Wilmington).

The meeting had four 90 minute working sessions:

In the first, the science teacher consultants summarized their perceptions of the problems confronted by their students (these statements were subsequently published in the S-STS Reporter, Volume 4 number 2, see below).

In the second, the science supervisors summarized the current efforts underway in their districts to address the problems of scientific and technological literacy for urban minority students. Special attention was given to new secondary science requirements and new courses initiated in the wake of reform proposals in such reports as A Nation at Risk and Educating Americans for the Twenty-first Century.

In the third, members of the Review Team presented findings based on their reviews of the scholarly literature on minority science education.

In the fourth session, the participants worked toward some common perceptions of needs, especially related to secondary science curriculum materials.

Two important common perceptions which emerged were that a) there was a perceived need for short multi-lesson units on science/technology/society topics especially addressed to the life experiences and problems faced by urban students, and b) there was an opportunity for the large urban school districts to develop these materials cooperatively. (In late 1987 a proposal was made by the Science through STS Project at Penn State to the materials division of the National Science Foundation to fund the development of such materials, but this proposal did not receive funding.)

Some initial guideline statements were drawn from the summary presentations, and Dr. Waks was directed to develop a further list of proposed guideline statements to be further elaborated and endorsed through a "Delphi" process.

4. Preparation of Guidelines (Fall 1987)

Mr. Dennis Cheek replaced Ms. Pit as Graduate Assistant in August 1987. Mr. Cheek, a doctoral student in science education, was a teacher-developer of the STS curriculum materials for the Department of Defense Dependents Schools (DODDS). His background included experience as a science and social studies teacher in Baltimore.

Mr. Cheek took responsibility for the development of the STS guidelines. Working with Franz Foltz, a quarter-time Graduate Assistant, Mr. Cheek derived a list of "proposed guidelines statements" from the review papers and minutes of the working group meeting. In the first round of a three round "Delphi" process these proposed guideline statements were sent to project participants and national STS education and minority education leaders for their assessment and revision. Eliminating those statements which failed to receive broad endorsement and making extensive changes to accommodate the many proposed revisions, a second round of statements was circulated for rating. After receiving further suggestions for refinement, a third list of guidelines was prepared and circulated for the endorsement of the participants.

5. Revision of Review Papers; Additional Review Papers Commissioned, (September-December 1987)

During the Fall term, 1987, the first drafts of the review papers were circulated to experts in STS education and minority science education for comments, and returned to the review authors for revisions. To accord with these comments, two new review papers were also commissioned:

* "Science Education for Urban Students: Current Problems and Potential Solutions," Dennis Cheek; and

* "Writing and STS for Urban Minority Students," Tonya Huber.

The revised review papers are all included as components or appendices of the final report of the project.

6. Presentations at the Third Technological Literacy Conference (February 1988)

The project sponsored a special session of the third National Technological Literacy Conference on February 5, 1988, "Implementing Science Learning through STS for Urban and Minority Learners." Drs. Stewart and Flint, and Mr. Cheek, made brief presentations on the topic "STS Education and the Inner-City Learner." Other presentations included: Marilyn Suiter, American Geological Institute, " Minorities in Geoscience: Academic Enrollment and Achievement," and Ken Alston, Benedict College and J. Elspeth Stucky, Duke University, " Science, Technology and At-risk Students: The Case for Literacy in the Lab."

7. Special Project Issue of the S-STS Reporter (April 1988)

In order to disseminate the results of the project, a special issue (Volume 4, number 2) of the S-STS Reporter in April 1988 was devoted entirely to STS in science education in the large urban districts. This 20 page report included articles by the principal investigator, Leonard Waks, by Anthony Galitsis (science supervisor, (New York City), and George Tressel (Program Director, Educational Materials Division, Science and Engineering Directorate, National Science Foundation. It also included a model urban STS program, statements on secondary science in large urban schools by the project's teacher consultants, a report on reading problems in science by Dr. Dupuis, the project guidelines, and an annotated bibliography on urban science education.

Under a grant from the National Science Foundation, this issue of the Reporter was distributed to over 5000 science educators throughout the nation.

Dr. Waks took medical leave from the project from May 1, through July 1, 1988. During this time Dr. Rubba was appointed as acting Project Director and subject to his instructions Mr. Cheek assumed operational direction of activities.

8. Meeting on One Year STS Course and Topics for Inclusion in Discipline-Based Science Courses (May 1988)

A meeting was held at University Park on May 20-21, 1988 to prepare over-all guidelines for the one year STS course and identify appropriate topics for inclusion as STS units in discipline-based science courses. Mr Cheek chaired the meeting; participants included Dr. Fagan, Dr. Dupuis, Dr. Rubba, Dr. Flint, Dr. Cora Turpin, Bill Strain, and Raj Rajan. After the meeting Mr. Cheek prepared minutes to the participants and prepared a brief report based on their comments and feedback.

9. Presentation at the National Conference on Precollege Education for Minorities in Science and Engineering (May 1988)

Mr. Cheek presented a paper "Improving the Quality of Secondary Science and Technology Instruction for Urban and Minority Students through Science/Technology/Society (STS)

Education," based on the project review papers and guidelines, at the National Conference on Precollege Education for Minorities in Science and Engineering at the New Jersey Institute of Technology in Newark, New Jersey Newark on May 24, 1988.

10. Review of Available STS Materials (Summer 1988)

In the Summer of 1988, Mr. Cheek conducted a content analysis of 12 available sets of STS materials to determine the extent to which they were in accord with the guidelines established by the Project. With the assistance of Mr. Andrew Beagle, a doctoral student in Reading Education, a readability study was also made of these curriculum materials.

Mr. Cheek's findings are that when project guidelines are used as standards, most of the available STS materials are not suitable without teacher adaptation for secondary science courses for urban/minority learners. The "Science and Society" course developed by the school district of Washington D.C. is one notable exception. This is not surprising when it is considered that this course was designed by urban teachers specifically for urban students. Strengths and weaknesses of other available materials were also noted, along with specific suggestions for teacher adaptation.

11. Background Paper on Puerto Rican Students (Fall 1988)

Because of the interests and expertise of Penn State Black Studies faculty and faculty members at Lincoln University, an historically Black institution, the project concentrated on the problems and needs of African-American students. However, there is also a large population of educationally disadvantaged students of Hispanic, primarily Puerto Rican, descent, in the Northeast and Middle Atlantic States and especially in New York City. In the Fall term, 1988, the project commissioned a background paper on Puerto Rican students from Dr. Margarita Pena of Penn State University.

12. Guidelines for STS in Secondary Social Studies

Dr. Pena, supported by a background paper commissioned from Dr. Rex Morrow of Penn State on current trends in the social studies related to STS, coordinated the work of a study group in formulating guidelines for STS in social studies. These guidelines are based on the project guidelines for STS in science as well as authoritative social studies guidelines (e.g. those issued by the National Commission on Citizenship).

13. Mini-Conference on STS and Black Studies (October 1988)

On October 20-21 1988 the project sponsored a mini-conference on STS and Black Studies. Participants included project associates Dr. Waks, Dr. Stewart, Dr. Fagan, Dr. Flint, Dr. Pena and Ms. Tonya Huber; Dr. Paul Bell, Director, Center for Education in STS, Penn State; and five members of the Penn State Black Studies Faculty: Collins Airhihenbuwa (health education), Roy Austin (sociology), Harold Cheatham (counseling psychology), Aaron Gresson (Education Theory and Policy and Center for the Study of Equity in Education), and Laverne Gyant (Doctoral Student, Adult Education). Review papers and guidelines were summarized and their implications considered by members of the Black Studies Faculty.

14. Working Group on Models and Examples of STS Units (October-November 1988)

In October 1988, Dr. Randall Wiesenmayer was hired as a consultant to work with teacher consultants Dr. Turpin and Ms. Arguello in developing a model of STS units and specific unit "vignettes" to serve as clear examples of units in accord with the Project guidelines. These mini-units are intended for illustrative purposes only. Dr. Wiesenmayer and the teacher consultants worked on October 20-21 in University Park and also attended several sessions of the mini-conference with the Black Studies faculty. In November Dr. Wiesenmayer prepared a report on models and examples of STS units.

15. Final Session at 1989 Technological Literacy Conference

In February 1989, Dr. Waks made a major presentation at the Fourth National Technological Literacy Conference on the process, guidelines, and conclusions of the "Enhancing Secondary Science through STS" Project. This activity was supported by funds provided by the National Association for STS, sponsor of the conference.

16. External Assessment

In November 1988, Dr. Matthew Bruce, Professor of Science Education at Temple University and established consultant and evaluator in secondary science education, was asked to review and assess the project. His report is included as an appendix to this report.

SCIENCE THROUGH SCIENCE/TECHNOLOGY/SOCIETY (STS) FOR URBAN MINORITY YOUTH

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From 1986-88 the associates of the "Enhancing Secondary Science through Science, Technology and Society Education for Urban Minority Youth" Project worked towards establishing guidelines for STS in secondary science. The guidelines, based on study, research, discussions, and a consensus-building process, are presented elsewhere in this report, along with background papers. In the process of developing these guidelines, three main ideas emerged:

a. It is critical for our society, not just on grounds of equity but for our national survival, to reverse the pattern of school-related difficulties and failures among members of disadvantaged minority groups;

b. Science, Technology and Society (STS) as a curriculum emphasis has an important and unique contribution to make to the secondary science education of urban and minority students; and

c. In order for STS to make this contribution, it must be shaped to empower the learning of disadvantaged minority youngsters in urban schools, and this involves new role-relations among teachers and school leaders, learners, and members of the urban minority communities.

In this paper I provide additional background, clarification and support for these ideas.

Education and Minority Groups: The Changing Context

In the 1960's and 1970's, the problems of urban minority education were interpreted in the educational policy arena largely in terms of "equity." The educational system was perceived to be doing an acceptable job for the "white majority," but (despite the achievements of the civil rights era) still failing with too many members of disadvantaged minority groups. While considerations of fairness demanded that we do better, minority education was not perceived as central to the economic, political or cultural well-being of our society as a whole.

Policy-oriented social science studies during those years, such as the widely-publicized reports by James Coleman (1966) and Christopher Jencks (1972), considered such questions as whether school could account for variability in academic achievement and economic success in later life. Arthur Jensen and others proposed genetic explanations of minority school failure.

In the 1980's the discussion of minority education has shifted from equity issues to concerns about national survival. Partly as a result, policy oriented research has shifted from a relatively passive attempt to account for the pattern of failure to a more active stance -- attempting to identify and replicate success. This is well illustrated in the "effective schools" literature. Ulric Neisser (1986) in a definitive review of recent research has noted the "ecological" character of recent discussions, in which causal efficacy is assigned to the impact of the social caste system, to cultural factors which conflict with the culture of schooling, and in school organization and pedagogical practices which weaken and disrupt student attempts to learn.

Behind this shift in research is the shifting demographic pattern in our nation and its schools, colleges, and workforce.

Changing Demographics of American Education

When our project was proposed in 1985, this changing demographic pattern of American education had not yet assumed the central place it now occupies in policy discussion. Minority education was still largely focused on equity concerns. Its importance for the well-being and even survival of our nation was not yet widely appreciated. The demographic data and their implications for the educational system had just been effectively presented in a report authored by Harold Hodgkinson (1985) for the Institute for Educational Leadership, All One System: Demographics of Education, Kindergarten through Graduate School. The basic demographic facts are now better known, but their implications for curriculum policy are still being digested by educators. In what follows some data are presented and their implications for education brought into focus.

Births. While the white population is failing to reproduce itself, the non-white groups are either holding steady or increasing in absolute terms, and are thus gaining larger relative share of the population. In order to maintain a steady state, the average female must bear about 2.1 children. The birth rate of the white population is 1.7 per female; of Puerto Ricans it is 2.1. For African-Americans the birth rate is 2.4 and for Mexican Americans it is 2.9. So as these children enter the schools and the work force, the demographic patterns in schools and workplaces change.

Where the school age population is increasing, it is due to larger numbers of minority children. Where school population is decreasing, it is due to a declining number of white children.

Age. The minority non-white population is younger. The average age of the white population is 31, African-American 25, and Hispanic 22. This means that the average white female is nearing the end of her child-bearing years while the average Hispanic female is entering hers. So the demographic change noted above will accelerate.

Aging Population. The population as a whole is aging -- the proportion of older Americans is increasing. In 1950 each retired person was supported by 17 workers. In 1992, this ratio will fall to one in three, and one of the three workers will be from a minority group.

Family Status. Normative patterns of family life and support systems for children are changing. In 1950 over 60% of all households with school age children were "typical" households with a working father, a non-working mother, and 2 or more children at home. In 1985 the percentage of households "typical" in this way had fallen to 7%, and was rapidly falling. Indeed, 60% of all school age children will experience living with just one parent (generally a working or non-working mother) before the school leaving age of 18.

The implication is that expectations about the home background and support systems in place for school-age children must be reconsidered and policy changes made to accommodate to new norms.

The nation is also experiencing an epidemic of out-of wedlock births, over half of which are to teen-aged parents. This is not a "minority" phenomenon: while the percentage of out of wedlock births is higher for non-whites, in absolute terms there are more white than minority out of wedlock teen births, and white females are more than twice as likely to have out of wedlock births in their teen years than their counterparts in any other industrial country.

The bottom line results of these changes are:

* Public schools everywhere will have larger percentages of children from disadvantaged minority groups, members of which have experienced and who continue to experience high proportions of school difficulties;

* Society as a whole, and the work force in particular, are changing to have an increasingly larger proportion of people from disadvantaged minority groups; and

* A higher percentage of school children in all groups will come from broken homes and will be born out of wedlock to teen age parents.

This is the challenge to the well-being and survival of our society. When these disadvantaged minority groups comprised a small proportion of school children, workers and citizens, it was possible for large percentages of individuals from these groups to fail without significant harm to the white population. The white majority was able to neglect the concerns of minorities, or even rig the system of educational and economic benefits against these groups, through segregation and job discrimination, without being forced to pay a high price.

But as these groups become a majority of the public school population and a very dominant proportion of the work force, they _eo ipso_ become the key to the health of our society in economic, political, and cultural terms. They hold the key to our future. If they fail our American society as a whole fails.

Social and Educational Implications of the New Demographics

How, more specifically, will our society fail if we cannot reverse the school-related problems and failures of disadvantaged minority groups? Following Henry Levin (1986), we may understand the risks in terms of (1) creation of a dual society marked by social and political upheaval, (2) a conflict in higher education, (3) workforce deterioration, and (4) a crisis of taxation and public costs.

1. _Dual Society_. Because of universal suffrage, disadvantaged groups can gain potential political power even if they fail to achieve economic equity. This raises the spectre of political conflict between "haves" and "have nots" organized around racial and ethnic themes. This would impose unbearable strains on our democratic institutions. Leaders such as Jesse Jackson, who have sought to build a rhetoric of coalition and harmony, may be replaced by minority leaders who, trading on the lack of knowledge and education of their constituents, appeal to their frustrations and baser instincts. Meanwhile, many in the white population may once again put forth "white power" advocates such as David Duke. In addition to the obvious inherent evils of intergroup conflict, such a politics of race and resentment also will certainly distract the nation from the pressing and complex issues now coming to the fore in our technologically-dominated society.

2. _Conflict in Higher Education_. As the proportion of school aged students from disadvantaged groups grows, then even with high drop out rates such students will continue to increase as a proportion of the age cohort to be recruited for post-secondary education. Institutions of higher education will have to find ways of recruiting and retaining them, just to meet their minimum enrollment needs and "stay in business. "

However, if school difficulties obstruct the learning of students from disadvantaged minority groups during their secondary school years, then either (a) a large and increasing proportion of the college and university students will experience academic failure in college, or (b) colleges and universities will be forced to shift increasingly to remedial functions and to lower academic standards, creating conflicts regarding the "culture" of these institutions. An early and bitter example of this was the battle over curriculum and standards at the City University of New York following the adoption of an "open admissions" policy.

The existence of academically under-prepared students recapitulates the "dual society" in higher education itself. "Conservative" forces rally to "preserve the character and standards" of the institutions, leading to intense conflict again organized largely along racial and ethnic lines about the appropriate mission, goals, standards, and curriculum of higher education. A recent battle in this war was the conflict over "Western Civilization" at Stanford. Conservatives sought to preserve the notion of Western Civilization as an organizing theme for general education, while many students and faculty members sought to develop a more "universal" conception of our cultural heritage, embracing the contributions of non-white, non-Western groups. Recent racial incidents at Michigan, Penn State, and other major Universities are also tied to the changing demographics and the new importance of non-white "non-traditional" students, with different learning histories, values and educational needs.

From the "conservative" side, victory in this battle means "preserving standards of excellence," maintaining "traditional" curriculum and conventions of academic achievement. Such a "victory" may be expected to have as a side effect intensified inter-group hostilities and intensified resentments among those in the workforce disqualified from college completion, when our economic and political institutions can least bear these strains.

3. Workforce Deterioration. Until recently, poorly educated workers from disadvantaged minorities were frequently able to find jobs with low educational qualifications, especially in the industrial sector. However, this sector of the economy is declining, and the service sector is expanding. The service sector is very heterogeneous in terms of educational qualifications and skill requirements, but it appears to most observers that a growing proportion of the work force is not qualified for emerging jobs. This includes not merely professional and technical jobs, but even the new jobs at the low end of the skill spectrum.

The lack of fit between basic skills and workplace demands places U.S. business and industry at a competitive disadvantage with those of other developed and developing nations. In many international comparisons of academic achievement, especially in science and mathematics, the United States finishes near the bottom. While Japan and Korea can graduate over 90 % of their cohort from secondary school, and effectively convey basic skills and cognitive routines, we can graduate only 70%, many of whom remain functionally illiterate. These facts stunned the nation when publicized by the National Commission on Excellence in Education (1983) in "A Nation at Risk."

It is frequently argued that those entering the workforce in the United States have lower levels of productive knowledge and skill than our competitors, and thus impose higher training costs and lower productivity on business and industry. This puts U.S. industry at a competitive disadvantage in the global technological economy, and that implies a lower tax base, an increasing balance of payments deficit, and a deflated value for U.S. currency. That erodes the value of individual wealth and income, implying a lower standard of living for Americans.

Concern about this is hardly confined to business leaders and conservative politicians. Liberal economists such as Lester Thurow of MIT emphasize the relationship between the "technological literacy" and "productive knowledge and skill" gaps and our trade and budget deficits. He points out that high-tech quality control workers need basics of algebra and statistics to perform routine job functions. IBM must teach its workers this knowledge, while Japanese firms can take it for granted among their entry level workers. The conclusion of this sort of argument is that unless we can reverse our patterns of school failure for the rapidly growing segment of disadvantaged minorities in our schools, the comparative quality of the American workforce will deteriorate further. Thus we will be forced to lower our standard of living either in the present, or, to pay for an ever-increasing foreign debt burden, even more dramatically in the future.

4. Crisis of Public Costs. Civil unrest, educational upheaval, economic decline -- these all impose additional cost burdens for the public. If we cannot reverse school difficulties and failures for disadvantaged minority groups, then our society will have large numbers of alienated and unemployable or marginally employable teens and young adults. These individuals become the welfare mothers, the drug and alcohol abusers, the anti-social, mentally ill and criminal elements of society, and they impose large public costs.

Failure effectively to integrate members of disadvantaged minorities into the economic mainstream of society during the school years places increasing burdens on the taxpayers. The costs of the welfare and criminal justice systems are increasing at the very time when the economy, faced with foreign competition, escalating expenses and increasing debt, can least bear such costs.

The "Excellence" Solution: Raising Standards

A series of national education reports has focused national attention on the poor performance of the American educational system. The first proposed solution to the problem of low academic achievement was advanced under the banner of "excellence." Most of the reports, following the lead of "A Nation at Risk," used the language of "excellence. " In practice, excellence meant raising standards, increasing school hours, emphasizing basics, establishing minimum competencies for high school graduation and minimum competency tests for teachers. National leaders directed leaders at the State and local levels to implement these reforms.

The impact on disadvantaged minority learners was predictable. While Governors put educational reform on the agenda, and state legislatures passed reform legislation, few states appropriated increased funds for improved performance. Standards were thus raised while many minority students were already failing to achieve the lower standards, and no additional assistance was provided. As a result, more minority students experienced frustration and failure and dropped out of school or failed to graduate. Harold Howe II (1983), Ernest Boyer (1984), and other leaders immediately predicted this unintended consequence of the "excellence" movement.

Minority educators were also quick to express their deep concerns. Faustine C. Jones-Wilson (1984) wrote that:

> The clear danger to blacks is that we might be ignored in the quest for excellence and quality since so many power holders seem to believe us incapable of attaining the highest standards of mental performance... (p. 98).
>
> Black students are failing competency tests in larger proportions than their white or Asian counterparts, and in some communities their Hispanic peers. As a result these youth will receive school attendance certificates, not high school diplomas, and will be unemployable unless remedial education and retesting are provided them.
>
> Black children, their parents, and their organized groups need to understand that the current mood is to test them out of the educational and employment pictures. It needs to be understood that the competition has increased for scarce

> places in education and employment ... The feeling is that people should merit education and employment opportunity, and merit is more than often determined by test scores (p.109).

The solution to the problem of education for disadvantaged minorities does not lie merely raising standards of achievement, although achievement will of course improve as the problem is addressed in more effective terms. As Boyer put it, "schools have less to do with "standards" than with people."

Redefining the Problem

The problem of education for disadvantaged minorities needs to be redefined in terms of people, their perceptions and needs.

To begin this process we must recognize that thinking about the problem in terms of "ethnic minorities" is misleading. This term focuses on cultural difference (ethnicity) and low percentages of the over-all population (minorities). These factors are no longer central to the problem in the way they once were.

Before the civil rights era there was blatant social, political, economic and cultural discrimination in our society, North and South, supported by custom and law. This pattern of historic racism imposed a stigma upon non-white minorities, involving denial of the right to vote and participate in civic life, the imposition of a job ceiling and the assignment of low status employment, then denial of equal protection of their laws, prohibition of social relations, and invidious comparisons of cultural activities and products.

In the years after the civil rights movement and civil rights legislation, historic racism and its associated stigma has been, while not ended, reduced and altered.

There are new opportunities for many members of once stigmatized non-white groups in education, in politics, in cultural life, and throughout all sectors of the economy including the professions, business and industry. This is one of the most significant facts of our times, but like most important "pluses" it has unintended "minuses."

One "minus" in the new situation is that those left behind face more difficult problems, with fewer supports. As individuals from the once stigmatized groups avail themselves of emerging opportunities, they move out of ghetto neighborhoods and the isolated "minority" community, and enter the "mainstream." To the extent that they do so on equal terms, with their cultural identities intact, they inter-act with members of the white population and continue to forge a more "universal" culture which partakes of the dynamic interaction of various ethnic groups in the mainstream.

Now we face a new problem of "residual" out-of-the-system individuals caught in the inner cities. This is not a problem of "ethnic minorities" but of but people without essential social resources. As those more capable of making, and keen to make, an accommodation to the educational and economic mainstream leave the disadvantaged communities, those left behind in the inner cities remain in situations increasingly emptied of individuals striving to succeed in the normative pattern of hard work and delayed gratification leading from educational achievement to economic success. This means, in the residual communities there are fewer models of success through the "work ethic," people who are working, achieving, becoming economically, culturally socially and politically affiliated. The very serious problems of those who remain in isolated "ghetto" conditions are no longer simply problems of race or ethnicity.

The problem which remains is not one of aspirations but of means for achieving them. Studies have shown that the aspirations of ghetto youngsters are not any lower than middle class youngsters in suburbs. What ghetto children lack are clearly demarcated pathways to success, to the achievement of their aspirations. What they lack are not "middle class values," as much as middle class resources.

The demarcation of success pathways has never been entirely or even predominantly the business of the schools. Family and community goals, models, and support systems have always been primary. Different groups have used the schools in somewhat different ways to achieve entry into the mainstream. The schools provided paths for these groups, but the groups had to search for and then light these paths, so to speak, with cultural factors (goals, support systems, models, work ethic) they themselves provided. The schools were instruments which in different ways served the somewhat diverse purposes brought to them by various groups.

There is no "culture of poverty" if this phrase implies the disadvantaged groups lack aspirations to succeed. Instead there is a "poverty-dominated culture" among the residual disadvantaged population, in the sense that the support systems, models, and work ethic needed to use the schools for success have all eroded as the most school-adaptable members of these groups have entered the mainstream and left the ghetto.

Among inner city residents, school children and their parents and neighbors, schools are not widely perceived as pathways to success. On the contrary, as John Ogbu and James Comer have each documented, the school is frequently perceived by the ghetto community as a hostile force. Because of the performance of the educational system in the era of historic racism, when schools for disadvantaged minority groups were frequently rigged for failure, these perceptions have considerable historical justification and cannot be dismissed as mere paranoia.

But reactive perceptions add to the problem. Many have written about the ghetto residents feelings of being trapped. For many school children, school itself is a trap laid by the white population. Ghetto students speak of school effort and success as "the whiteman's way." This way of thinking blinds young people to the opportunities which may exist in their school situations. As John Ogbu puts it, the reasons for minority school learning difficulties are to be found " both in the ways the wider society (including the schools) treats the minorities and the way the minorities themselves respond to the treatment (Ogbu, 1985, p.864). His data suggest that Black children begin to internalize a distrustful attitude towards schools early in their school careers, and he notes that children with such an attitude have greater difficulty accepting and following school rules of behavior for achievement.

To summarize to this point: the school-aged children and youth and their parents have high aspirations for success but lack clearly demarcated pathways. They frequently see the schools as pathways to disappointment, frustration and failure, not success. Such perceptions can lead to reactive attitudes and behaviors which obstruct school commitment and academic achievement.

The problem of school commitment is compounded by the existence of a well-elaborated "oppositional" cultural alternative -- which, as Ogbu notes, includes different styles of talking, thinking, feeling and acting. One important dimension of this alternative is the street culture and the "gang," with its associated behaviors of truancy, delinquency, petty crime, and violence.

The gang is certainly among the most misunderstood and devalued of social forms. Sociologists have frequently pointed to its positive as well as negative features, including loyalties, fraternity, socialization of group norms in an otherwise normless situation, etc. The gang and its associated pattern of delinquency is also a form of economic activity and a pathway to the criminal economy.

In large cities the gang culture affects, in large ways or small, the lives of almost every inner city young person from early teen through late teen years (Kinsburg, 1975).

For many young people the question is "which way is right, street or school? " The children rely upon one another, and breaking with their peer culture is very threatening. To be marked as a "Tom," as going the "whiteman's way," is to face ostracism from the one system that provides meaningful support, clear norms and demarcated pathways of life. As Ogbu states the point:

> Inner-city black youngsters and similar children may define academic success as more appropriate for whites; therefore minority students who do well academically are regarded as "acting white" or "strange" and are subject to peer pressure to change. The dilemma is ... that they often feel forced to choose between doing well in school and manufacturing their group membership in good standing (866).

As Dr. Cora Turpin, a senior science teacher in Philadelphia and one of our project associates put it, the kids have "nobody to fall back upon; life for them is a singular effort. The peer group is crucial to survival, and the kids must accommodate to their peers. They are tortured for setting high academic standards." And Maria Arguello, also a senior science teacher and project associate, added: " the kids depend upon one another for support and even survival. So looking good in front of peers is crucial. If teachers threaten their image with peers, they are threatening their very survival."

Ogbu draws the conclusion that at the level of practice, teachers and schools need to "develop programs to help these minority children learn how not to equate mastery of school culture with loss of group identity and security (Ogbu, 1985, 868, his emphasis).

The problem is further compounded by unequal provisions for educational finance, the growing shortage of superior teachers who can penetrate the inner world of the ghetto youngster, and deteriorating school buildings. These send a message to the students that the system doesn't care.

To draw the main implications of this section:

The problem of "minority education" does not reside in either ethnic differences or in the small relative proportion of these groups in the population. The groups are growing in size and importance, and with the decline of historic racism many members of these groups are entering and making major contributions to the mainstream society. We are now faced with a new problem: a growing population of individuals left behind despite the inroads against historic racism.

This problem is not a "technical" problem" of finding the "right educational methods" to teach disadvantaged youth, and especially not a problem about "low academic abilities."

The problem is not really "how to teach these kids" at all, but the prior problem of "how to win their hearts and minds." This can only be done on terms which are understandable, believable, and appealing to them. Very little going on in comprehensive high schools now can meet this test.

Mary Ann Raywid puts this point well:

> There is obviously a serious mismatch between many of our high schools and the students they are supposed to be serving. We must change that and change it soon. If we are serious about wanting to keep prospective dropouts in school, then clearly what we must do is change the way they feel about school. They have to be convinced that education is of value, that it is worthwhile and can make a difference in their lives.
>
> It is the simple fact that they hate school... so that if we want to keep "at risk" youngsters in school we are going to have to provide a different kind of school environment...a different kind of place, with a different kind of organizational structure and a different feel and flavor.

There is no way to simply "whitewash" this problem; rather we must change the relationship of school, learner and community in very fundamental ways. We have to make the relationship work, so that it can maintain learner commitment despite the large demands it places on the learners, along with frustrations and occasional setbacks. What might this look like, and how can STS play a role?

Domination, Advocacy, and Empowerment

There are several conceptual frameworks in the literature for understanding the educational problems of disadvantaged minorities. Our project associates found those which centered on the themes of domination, advocacy and empowerment (Cummins, 1986; Ogbu, 1985, 1986) particularly relevant. They also saw a need to augment these ideas to emphasize the active role of the learners in resisting (not merely being disabled by) inappropriate school routines (Welsh, 1987)

To such researchers as John Ogbu and Jim Cummins, the school problems of disadvantaged minority members lie in the re-establishment in school of the very forms of social relationship in the larger society which dis-empower these youngsters, de-valuing them and weakening their energies for school learning. Whatever other changes may or may not be appropriate in the curriculum content, primary reform is "dependent on educators, collectively and individually, re- defining their roles with respect to minority students and communities (Cummins)." Role definitions and structures in the classroom, and the dynamics of role interactions, either empower or disable learners.

Cummins conducted analyses of cross-national empirical data on the academic achievement of individuals in low status groups. His research indicates that educational programs for such groups are successful to the extent that:

(1) minority student language and culture is incorporated in the school program;

(2) minority community participation is encouraged as an integral part of the learner's education;

(3) the methods of pedagogy promote intrinsic motivation on the part of students to use language actively to generate their own knowledge; and

(4) professionals involved in assessment become advocates of learners rather than legitimating the location of the "problem" in the learner.

On this analysis the problem resides not so much in the content of the school curriculum, as in the relational context. Useful change will not result from new curriculum content but only from a more "user friendly" context for schooling. The message to learners and community residents must be: the schools are here to assist us in improving our lives, expressing our unique personal and cultural identities, and solving our common problems.

Trubowitz notes that the feelings of young people are a "facet of all curriculum content," and that youngsters will not accept or become involved with curriculum content that does not take their feelings into account." But when they "sense that their vital needs -- as represented by their inner emotions -- are understood and dealt with, then communication and cooperation are encouraged (Trubowitz, 1968, p. 92).

A contextual change does not necessarily demand a wholesale revision of curriculum content. From a practical standpoint that is a good thing, because minority education leaders tend to reject wholesale curriculum content revision. They do not want minority children to be guinea pigs for educational experiments, but rather want the same "quality" education which in their view has worked for the white children who have experienced educational and economic success. When a user-friendly relational context is established and communicated convincingly, much of the old curriculum content can be reconfigured and infused with new meaning and relevance. This applies to many components of the discipline-based science curriculum, as the American Chemical Society's CHEMCOM (Chemistry in the Community) course amply demonstrates.

What is the relationship between the new relational context prescribed by Cummins and STS as an emphasis and organizing theme in science education?

1. Minority Language and Culture. Language is the heart and soul of the learner. Language (reading, writing, thinking, speaking, listening and interpreting) is not merely a "skill," but rather it is voice, spirit, soul. Language implies deep cultural roots transformed through personal self-expression and construction of meaning.

As William Labov (1972) and others have demonstrated, Black American English is a highly subtle, nuanced, and expressive language. The issue our project faced was not whether Black or "Standard" English, or Spanish, etc., should be used as the language of instruction. Even if so-called standard English is used in instruction, the native language of the learner must still be understood and valued. As Charlotte Brooks has said, to deny the child's language is to deny the child.

Barry Kinsburg has emphasized that the gang and street culture is, as much as anything, a context for expressive language use. The leader of the gang is given the title of "runner," and Kinsburg notes that in Black ghetto argot, to "run it" means to talk or tell a story. He adds:

> The runner may be thought of as the "talker" or "story teller." Several gang researchers have stressed the high value placed on verbal ability by adolescents... Members of gangs feel that verbal ability is a central characteristic of leaders....Runners were the leaders of the daily routine. On the corners, we observed that leaders would often be in a center of a close semi-circle of gang members dominating the conversation of the group (Kinsburg, 1975, 66-7).

However, the verbal ability of the "runners" and other inner city youth may not be detected by mainstream professionals or standardized tests.

Kinsburg provides the telling example of one prominent Philadelphia gang "runner," "Deacon." Two psychologists who examined him had a dim view of his abilities. The first reported Deacon's verbal IQ to be 87, and his reading level at age 17.2 to be 1.7. His report called Deacon "slow-functioning" and stated that "in verbal efforts the boy indicated substantial limitations." The second psychologist ended his report by asserting that Deacon "appears without talent of any kind." (Kinsburg, p. 19).

Yet Kinsburg's own observations of Deacon contradicted these reports:

> A debate with him required a great deal of skill, but even then one could never expect to have the last word. Other gang leaders, when asked why Deacon dominated, ...stated " Deacon can rap for us: he knows what we feel." He displayed a quick and subtle mind, and was a great creator of phrases... He was the elaborator, the teller, the one who would explain at length, and almost without argument, the thinking and feeling of the group. (Deacon was) the center of attention, telling jokes, engaging in verbal repartee....and performing an almost continuous monologue about the real and mythical activities of fellow gang members.

Such reports from the field should help us to understand why youngsters associate the culture of the school, and its aura of language constraint and correction, which they contrast with the expressive street culture, as a kind of personal and cultural homicide -- they feel dead in school; as Raywid insists, they "hate and detest" the school experience.

Sidney Trubowitz (1968) notes with irony, that " children who can insult each other with a neat turn of phrase are not totally without language ability." He adds: "the use of highly figurative language, understood only by the initiated, may be the children's way of showing their power over society and authority." (p. 89).

STS issues, with their focus on values, on diverse cultural definitions of problems, and on diverse solutions based on the use of cultural resources rooted in diverse traditions, are a channel through which expressive language can flow. Young people can express their ideas, wishes, hopes, and plans, and discover that these are regarded as interesting, important, and "on target." Learners can give vent to their feelings of anger and frustration, and their need to have a greater control over their environment. Through this process, they can see that their own language permits an enjoyable play of imagination which is accepted and admired in school, that there is an adult audience for their experiences and hopes, and as Trubowitz (p. 89) puts it, " an acceptance of the idea of possible change."

2. Active Community Participation. Cummins notes that community participation must be encouraged as an integral part of the learner's education. This contrasts sharply with the invidious comparison between the "civilized" culture of the

school and the "barbarians" beyond the gates. It implies acknowledgement of the value and worth of viewpoints in the community. It means opening up the wall of separation between school and community, so that much learning is "community-based" and places youngsters in contact with adults in the community. And it means making the school a significant resource for the adult community, through continuing education, information and public awareness activities.

It does not mean "token" participation to satisfy some bureaucratic demand for participation, e.g. a rubber stamp parent curriculum committee. Empirical studies show that such forms of participation have no impact on school achievement, and we should hardly expect that they would.

Encouraging participation depends upon (a) recognizing that life in the disadvantaged minority communities has some positive elements which are educative in the best sense, and (b) making the problems of living in the community a relevant and important focus of learning.

STS education provides several means for enhancing relations between the school and the minority community.

Issues such as solid waste management, chemical pollution of the air and water, urban health problems, changing workplace quality and declining industrial jobs, high-rise housing, noise pollution and crowding, heroic measures to save low weight babies, AIDS, and illicit drugs all bear on urban youth. STS units on such issues can draw upon the learners' experience of their urban environment and enrich it.

As Trubowitz notes:

> Children are in daily contact with other city agencies. They include the Park Department, the Department of Sanitation, the Rapid Transit System, the Department of Gas and Electricity, and the Department of Water Supply. By focusing on the work of city agencies, by arranging for more personal contact with these agencies, and by exploring in depth the effect of agency work, the school can help the children develop a clear understanding of this aspect of the world around them.

Leaders within the community, representing the professions, city administration, and community groups can be called into the classroom to address urban issues. Or students can learn about these problems at first hand through community-based learning activities.

The school can sponsor STS "short courses" and "briefings" so that parents and community residents can gain in awareness about the problems facing their communities. Community leaders can participate in such efforts, building support in the community to address problems by political action. By such participation, members of the community can strengthen their ties of loyalty and support for their schools.

Students can also learn actively to seek solutions to problems they have passively endured, and their own learning activities can be part of the solution, e.g. in an environmental campaign.

3. Intrinsic Motivation to Use Language Actively to Generate Knowledge. This component implies that youngsters learn through defining situations in their own terms, defining problems and proposed solutions in terms of their own cultural values. It takes "active language use" to the level of "knowledge." This means breaking the cultural stereotype of knowledge as a static entity expressed in a foreign language in a textbook. It stands against the shaping and constraining of language implicit in passive text-book learning and the one culturally defined "right answer."

STS units contribute directly, because in them the focus of "knowledge" shifts from the "text-book" problem and the one right answer to real problems encountered in the community. Their own direct experience and that of community residents, their interpretations, analyses, and different solutions are relevant "knowledge."

4. Assessment for Advocacy. This kind of assessment means that the "evaluator" is open and actively seeks out the power, elegance, simplicity, intelligence, courage and other virtues in the responses learners actually make to situations which concern them. This compares with the gate keeper notion of evaluation, based on behavioral objectives, standardized tests and minimum competencies, the red pencil and the failing grade.

Assessment for advocacy means defining the educational situation holistically, in terms that learners find convincing, and with goals which are personally meaningful, however demanding. It goes beyond "judgment" and "standards" to actively discover worth and merit in the learner's mode of approaching the tasks at hand, building on what is positive and correcting what is negative in clear but non-judgmental terms.

STS education lends itself to this mode of assessment, for its goal is not inert knowledge but the active participation and empowerment of learners.

STS in Secondary Science Education

STS education is one already established curriculum emphasis in science instruction. It is not a new invention geared for "low ability" students, but rather an innovation for all students which has won the enthusiastic endorsement of the leading professional associations and government agencies such as the National Science Teachers Association, The American Association for the Advancement of Science, and the Science Education Directorate of the National Science Foundation.

As defined in the literature of science education, and implemented as a curriculum emphasis, it lends itself well to the changed role-definitions summarized above.

Among currently authorized curriculum reforms in science education, it is the only one which does so. For this reason STS is the best currently available window for such reforms in the established science curriculum. This is its unique contribution.

However, in urban schools STS must be implemented so as to emphasize these new role-definitions. Unfortunately, many ways of implementing STS fail to achieve this potential. The STS unit on "acid rain," drawing heavily on knowledge and concepts unfamiliar to urban learners and approaching a problem far from their experience or concerns, presented as authoritative knowledge by teachers to passive learners expected to learn the right answers, will not make any difference in inner-city schools. The guidelines and background papers which follow are intended to point the way toward a conception of STS in secondary science which will make a difference.

WORKS CITED

Boyer, Ernest (1984). "Reflections on the Great Debate of 1983." Phi Delta Kappan, 65, 8, p. 525-30.

Coleman, James (1966). Equality of Educational Opportunity (Summary). Washington D.C. U.S. Dept. of Health, Education and Welfare, Office of Education.

Cummins, Jim (1986). "Empowering Minority Students: A Framework for Intervention." Harvard Educational Review 56, 1, p. 18-36.

Hodgkinson, Harold (1985). All One System: Demographics of Education, Kindergarten through Graduate School. Washington D.C., Institute for Educational Leadership.

Howe, Harold II (1983). "Education Moves to Center Stage: An Overview of Recent Studies," Phi Delta Kappan, 65, p. 167-172.

Jencks, Christopher (1972). Inequality. New York, Basic Books.

Jones-Wilson, Faustine C. (1984). "The State of Urban Education." In The State of Black America 1984, National Urban League.

Kinsburg, Barry (1975). The Gang and the Community. San Francisco, R and E Research Associates.

Labov, William (1972). "The Logic of Non-Standard English," in P.P. Giglioli, ed., Language and Social Context, Penguin, p. 179-216.

Levin, Henry (1986). Educational Reform for Disadvantaged Students: An Emerging Crisis. Westhaven Ct., National Education Association Professional Library.

National Commission on Excellence in Education. A Nation at Risk: The Imperative for School Reform. Washington D.C. U.S. Department of Education.

Neisser, Ulric (1986). The School Achievement of Minority Children: New Perspectives. Hillsdale New Jersey, Erlbaum.

Ogbu, John U. (1985)."Research Currents: Cultural-Ecological Influences on Minority School Learning. Language Arts, 62, 8, p. 860-869.

--------(1986). "The Consequences of the American Caste System," Chapter 2 in Neisser, The School Achievement of Minority Children.

Raywid, Mary Anne (1987). "Making School Work for the New Majority." Journal of Negro Education, 56, 2, 221-227.

Trubowitz, Sidney (1968). A Handbook for Teaching in the Ghetto School. Chicago, Quadrangle Books.

Welsh, Catherine E. (1987). "Schooling and the Civic Exclusion of Latinos: Toward A Discourse of Dissonance." Journal of Education, 169, 2, p. 115-131.

STS Education and Empowerment

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Inner-city youth who are low-achievers--as defined by mainstream standards--may be reflecting not low ability but lack of identification with the percieved values of schools. If those values are considered "white" values, then, such youth will be under considerable pressure from peers to resist endorsing those values in what they do. They may look at endorsing such values as caving in to the pressures of the mainstream. Clearly, there is a need to shift perspectives on this matter. One model recently proposed is that of empowerment. It will be proposed that multicultural education and other forms of approach to inner-city youth ought to empower them. This involves preparing them for citizen action on STS matters in which they gain some measure of control over their environment.

1. Multicultural Education

It will be useful to start this discussion with the notion of multicultural education. According to the model of "structural pluralism," ethnic groups in America have experienced cultural assimilation, but retain ethnic subcultures.1 Partial assimilation has occurred, but total assimilation has not. Also, "multiple acculturation" has occurred, not mere assimilation to the dominant WASP culture. Cultural assimilation is not unidirectional from WASP to Black culture, but occurs in both directions. A more universal American culture has resulted from a series of multiple acculturations. While the WASP culture has had a great influence on this universal culture, other ethnic cultures--such as Black, Jew, and Chicano--have influenced and continue to influence the universal American culture as well.

This more univeral culture is not the same as the WASP culture, since its character is defined by multiple acculturations. There is a tendency among ghetto youth, however to identify this culture with white culture. Hence, the educational task is both to shape black self-concept through examination of the cultural heritage of African-Americans, and to show the contributions of blacks to the universal culture, thus weening such youth from the identification of the universal culture with white culture. In the area of science and technology, it is particularly important to emphasize the achievements of black scientists, engineers, and inventors.

1James A. Banks, "The Nature of Multiethnic Education," in James A. Banks ed., Education in the 80's: Multiethnic Education, NEA, (Washington, 1981), p. 19

A key goal of education, on this view, would be to facilitate cross-cultural competence of students, enabling them to both function within their own ethnic subculture and to function within the universal American culture--the so-called mainstream. This would involve rejecting assimilationist ideologies which assume that educational goals ought to be WASP goals. Schools would reflect a multiethnic ideology. Hence, black students would be well educated in African-American traditions and culture and in the universal culture of American society. They would develop cross-cultural competency, enabling them to function in both the universal culture and in the black subculture. School staffing, curricula policy, hidden curricula, learning styles, dialects, counseling and assessment, instructional materials, teaching styles, community participation, and values would be assessed in terms of this multiethnic ideal.

This recommendation for reform of the social ideology of American society envisions American society as containing a mainstream culture which is the synthesis of contributions of many different subcultures. But this mainstream never completely absorbs the subcultures. The model, then, makes ethnic diversity a virtue, while implicitly emphasizing a norm of tolerance and respect for each ethnic subculture. School reform along these lines would lead the way in the ideological reform of the whole society.

The emphasis on special learning of contributions of one's subculture underscores Kunjufu's emphasis on black children learning their history, traditions, and people. Where black children learn their African-American heritage, their self-concept should come to include reference to that heritage. Hence, education which aims to socialize black children exclusively in Anglo-American values is wrong, and it is wrong to merely train such children for economic productivity.[2] It contributes too easily to negative black self-concept which interprets the black student as having an inferior status. Emphasis on an African-American frame of reference counters this tendency, as it does the tendency to attempt total assimilation to Anglo-American values. African emphases on "we," cooperation, and the internal may then replace the American values emphasizing "I," competition, and the external. Kunjufu advocates a return to the African values as an important part of the education of black children.

2. Critical Thinking and Multicultural Education

Kunjufu emphasizes the education should not be replaced by training. Because of the castelike status of black children, liberation is an essential goal of their education. Hence, raising consciousness of their African heritage and of the nature of the enemy is an educational goal, as well as mastering the tools of the culture needed for survival. Kunjufu draws on Freire's discussion of the "banking" model of education, according to which students passively receive, store, and file deposits of

[2] Jawanza Kunjufu, Developing Positive Self-Images & Discipline in Black Children, (Chicago, 1984), p. 30.

information, while the teacher imparts his expert knowledge to them. Freire rightly points out that such traditional models of pedagogy are politically significant in teaching minority students because they perpetuate the oppression of the minority group, rather than to transform it.3

The solution is to adopt a mode of pedagogy which transforms the oppressive relationship to minority groups in the classroom. Hence, Kunjufu emphasizes a circular cognitive approach to teaching and learning rather than a banking model. In that approach, students and teachers mutually influence each other, and the focus is on solving problems and thinking rather than merely memorizing. Such an emphasis, he suggests is appropriate for the kinds of demands made on students in a post-industrial age the nature of which requires thinking and problem-solving skills.

The emphasis on thinking skills can be usefully combined with the multiethnic approach by noting that in a multicultural society students will be faced with cultural conflict. It has been suggested that such cultural conflict does not cause pathological maladjustment, even though it may cause cognitive dissonance. As the student becomes aware of such conflict, however, the student will have to become conscious both of his own subcultural heritage but also of with other cultural values. Finding some new solution to such a conflict will call forth the development of thinking skills which require comparing and weighing various considerations relevant to the solution of such conflicts. The situation invites uncovering layers of meaning and understanding which might otherwise be closed to conscious consideration. In this sense the multiethnic education of students poses the problems of conflicts of cultural values to them to solve. Emphasize on problem-solving empowers students to seek their own solutions.

3. Empowerment and Education

Multi-cultural education which affirms one's own cultural heritage may be viewed as education that empowers the student. Education that empowers, however, concerns both the content and the process of education. Cummins has suggested that a key to the empowerment of minority students is the sort of interactions they have with school educators. Empowering interactions are primarily collaborative, and they become an operational way to reverse the dominant-dominated power relations of the larger society. Hence, school experiences should primarily empower students in ways that support their reference group identity, provide appropriate knowledge, and interactional patterns. The emphasis of an empowering model is on bilingual education, collaboration with parents, reciprocal interaction with students, and advocacy oriented assessment.4

[3] Paulo Freire, Pedagogy of the Oppressed, (New York, 1970), p. 58.

[4] Jim Cummins, "Empowering Minority Students: A Framework for Intervention," in Harvard Educational Review, Vol 56, No. 1, February, 1986.

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Bilingual education empowers by not denigrating the language or dialect of minority groups. While "network standard" English is taught, for example, this is not taken to imply that Black English is impoverished.5 These alternative dialects each have their own context of useful function, but one is not the right English while the other is defective. Network English is the language of the universal mainstream, and is oriented toward the rationalistic and utilitarian character of that mainstream. Black English provides an expressive and personable means of communication within black cultural contexts, and serves to maintain black cultural boundaries. Students are assisted to understand the functional values of each dialect, so that they are able to choose in which situations they will use one or the other. Their education permits them greater choice and control over their situation.

The existential experience of a student who is merely corrected for "improper" English is that his native dialect is wrong or bad. Hence, the emphasis on the mutual learning of teacher and student, where teachers learn from discussions with students of terms and meanings in Black English enables students to learn network standard English without feeling they are giving up a black cultural trait. Discussing the learning of network standard English as itself a "technology" which needs to be learned because of its functional value in the marketplace need not convey the existential disvalue of Black English. Students will learn network English more easily if so doing is not perceived as a threat to cultural identity.

This shows the key emphasis of empowering education is a collaborative mode of interaction with parents and students. Teachers work with parents and students, rather than to lecture to them. One particularly important classroom activity may involve student to student dialogue to emphasize the "we" values Kunjufu speaks of. The process of the class then represents a negation of the oppressive relationship.

4. STS and Empowerment

This brief survey of approaches to education gives us some basis for understanding the role of STS as an educational strategy. STS is concerned with political and social action affecting science and technology related social issues. If STS is concerned with action-oriented problem solving regarding such issues, then STS can lead to a new twist on the empowerment of black urban youth. The urban environment itself contains a high proportion of technological components, including drugs, roads, housing, transportation, and the like. It also is highly affected by the side effects of technology. The technological ingredients in the environment of urban minority youth will have both beneficial and harmful dimensions. It is empowering of such youth if they are able to become conscious of the technologies in their environment and more able to control or influence their impact.

5J.L. Dillard, Black English, (New York, 1972), pp. 268-269.

If such youth are encouraged to do problem-solving in an action-oriented way regarding the technologies in their environment, then STS can contribute to that empowerment. They learn action-oriented uses of knowledge, skills, and impacts of technologies in their environment. To this extent, school can become relevant to them from their definition of reality.

There are two broad areas in which this may occur. First, such youth may learn to solve problems in their environment through use, modifification, and invention of technologies, or the direct management of the "side effects" of technology. They may see the value of this through examination of the history of contributions of blacks to science and technology. Even that history could be seen as a history in which technologies are invented in order to solve problems. Second, where technologies in their environment have a direct impact on them (including, for example, drugs), such youth may learn what those effects are in order to encourage responsible decision making regarding such technologies. In earlier years, such learning may be largely experiential, where the impacts of such technologies are observed. Later on, however, scientific and technological concepts may be introduced to facilitate understanding and appropriate action. The objective would be to facilitate responsible personal and civic decision making regarding technology.

To accomplish these objectives, however, schools must work collaboratively with parents and children to define the social issues regarding science and technology. STS approaches, materials, issues, and the like will need to be adjusted to the real life concerns and needs of parents and children. STS questions need to be framed so that minority youth and their parents can identify with the issues. Further, examination of science and technological questions can also be utilized as a means of developing career awareness among such youth. Many minority youth who do make it in the mainstream do so by moving into career positions which are generated by new technologies. In this way, STS approaches can facilitate awareness of new career opportunities. At the college level we have discovered that this has happened.

STS approaches have been responses to the felt need to uncover and consider the moral and value questions implicit in science and technology. What STS approaches may do, then, is to provide students an opportunity to think about such values in comparison with their own values and situations. They may consider, for example, the values implicit in public transportation versus private modes of transportation. Good public transportation may reduce congestion, equalize access to jobs, and reduce air pollution. Disproportionate emphasis on private transportation may cut off opportunities for those who lack resources. Through raising such issues with them, minority group parents and children may become aware of value issues not previously considered. They may then be more able to make responsible personal and civic choices concerning those issues.

5. An STS approach: sketches toward guidelines

STS in urban minority schools will face the same difficulties as other educational reforms if it does not deal effectively with the issues of castelike status and social and economic disadvantages caused by historic racism. It could easily become one more program reflecting majority values. So putting together an STS course or including STS elements in courses will not address these fundamental problems unless this approach is pursued in the context of empowerment strategies. But with its action-oriented and practical focus, STS approaches can usefully augment those strategies.

1. STS APPROACHES SHOULD START WITH TECHNOLOGICAL AND SCIENCE IMPACTS MINORITY YOUTH CAN IDENTIFY WITH.

STS approaches may involve consideration of technologies in the environment of students, with attention to the tradeoffs of using such technologies. It could consider drugs, contraceptives, abestos, transportation, television and radio, medical, buildings, and other technologies with which the student has encounters. In each case, the technologies reflect embedded values, and this becomes clear through comparison of them with alternatives. The student's becoming more conscious of those values and at the same time of his own values empowers him to make choices where previously he had no options.

STS approaches should consider issues the minority youth can identify with and which are experienced by such youth as real, even if initially not identified as an STS issue.

2. STS APPROACHES SHOULD EXPAND HORIZONS IN THE MINORITY YOUTH'S DEFINITION OF REALITY BY EXAMINING MAINSTREAM TECHNOLOGIES AND THEIR IMPACTS.

STS approaches may also lay bear the structure of the mainstream economic system, including the changes in the city which affect minority youth. Comprehending the basic changes in structure of the urban technology and economy enables the minority student to consider effective adjustments. One of the problems mentioned earlier was that students sometimes make adjustments which have an immediate advantage for them, but they do not see its disadvantages when viewed in a larger context. STS may give students the big picture of their situation, thus enabling students to make choices which are not self-defeating.

3. STS APPROACHES SHOULD PROVIDE OPPORTUNITIES FOR SCHOOL AND COMMUNITY-PARENT COLLABORATION.

STS approaches will also provide opportunities for collaborative activities with parents. Parents may be involved with students in addressing immediate social problems which have a technology and science component. AIDS education offers one such opportunity, and drug education another. Reinforcing the linkages between parents and schools in this context may counter the temptations of downwardly mobile directions in a student's life.

4. BLACK ENGLISH AND NETWORK ENGLISH MIGHT BE VIEWED AS TECHNOLOGIES OF COMMUNICATION WITH A STRESS ON THEIR RELATIVE FUNCTIONAL VALUES.

It is helpful to analyze languages and dialects as technologies used for communication, and to help students to become self-conscious of the roles and functions of various dialects in their lives. This will enable teachers to deal with the student's existential experience of having his or her English "corrected." It will make the issue of learning network English a practical one of increasing marketplace opportunities, rather than one which makes the student feel that what he or she speaks is simply wrong.

5. STS APPROACHES SHOULD PROVIDE POWERFUL EXPERIENCES WHICH ALTER AND EXPAND THE MINORITY YOUTH'S DEFINITION OF REALITY.

This will involve detachment and development of new syntheses concerning race identity, race pride, and values. Constricting definitions of reality need to be expanded, successful educational and labor market performance needs to be legitimated where needed, and increases in communication between middle class and urban poor blacks need to be emphasized.

An important emphasis might be to have middle class blacks talk with urban minority youth on a regular basis, and to give their experiences in the mainstream.

Conclusion

The proposal, here, is that STS adds an important action-oriented ingredient to the education of inner-city youth. That action oriented ingredient may be an excellent way to empower such youth through the educational process. If it does, then the alienation from that process will be less likely to occur. Also, given the cultural dimension of science and technology, emphasis on black scientists, engineers, and inventors can be one way to affirm the Afro-American heritage. Finally, action oriented problem solving will facilitate the development of important thinking skills on the part of inner-city youth. STS issues are excellent issues for that sort of activity. Hence, STS provides an excellent focal point for empowerment, critical thinking, and multi-cultural educational strategies for inner city black youth. In that regard, it can indeed be powerful emphasis inner-city schools.

Black Youth in Urban Schools
Attrition, Self-Concept, and Performance

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According to a recent study by the Philadelphia School District, nearly 35 to 40 percent of the class of 1988 would probably not receive a high school degree.[1] The study found that the highest dropout rate was among Hispanic males with Black males next, that males where more likely to dropout than females, and that most dropouts leave school at age 17 when no longer legally required to attend.[2] On the other hand, the same study reveals that in some urban schools--especially those which have selected admissions--hardly any students drop out.[3] So there is a spectrum of secondary school students, from those who identify personal goals and aspirations with the schools they attend to those who are entirely alienated from the educational process. In this review, we look at the motivation for educational achievement for black youth, with special attention to the role of the family and the black student's definition of reality. We suggest that the most appropriate educational response to black youth is an empowerment strategy, and that STS approaches to urban minority youth can be integral parts of such a strategy.

1. The Definition of Reality of Urban Minority Youth

A key concept utilized throughout this document is the definition of reality of urban minority youth. We assume that especially in one's early years, one's definition of reality is built up out of one's range of experiences. As the urban minority youth grows and develops, he or she has experiences with significant others, family, and peers. He or she also encounters an environment of dilapidated housing, chemical dependence, welfare institutions, and the media. Unfortunately, these experiences are often all the minority youth has. Since the minority youth's definition of reality is built up out of those experiences, it is limited by whatever limitations exist in his or her experiential universe. Hence, he or she may not perceive opportunities for escape from such conditions because these opportunities are not part of his or her experiential universe.

Nevertheless, just as his or her definition of reality constricts opportunities, so it may expand the range of opportunities for the urban minority youth. Schools may do this by providing cognitive and interpersonal experiences which alter or significantly improve the urban minority youth's definition of reality. Such interventions by the schools are perhaps a rare opportunity to alter perceptions which would otherwise become increasingly fixed as the youth grows older. They may do this by opening up windows of opportunities which were not previously perceived by such youth. Unfortunately, if schools do not show the way to more expanded life chances, the urban minority youth's definition of reality will likely involve the assumption that there is nothing for him or her in the mainstream society. This is because school institutions provide one of the few opportunities he or she has to make contact with the mainstream. He or she will come to accept a castelike status as a given in life. Both the urban minority youth and the larger society will suffer the harm that comes from this failure by the schools. The society will lose productive citizens, and the urban minority youth will miss out on many good opportunities in life.

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[1] "District's Study of Dropouts Paints a Grim Picture," The Philadelphia Inquirer, Sunday, July 5, 1987.

[2] Ibid., p. 6A.

[3] Ibid., p. 7A

Our discussion will elaborate on this thesis. We will begin, therefore, by mapping the environment of the urban minority youth. Most central is the early experience in the family, for the family supplies the youth with primary experiences which permanently shape his or her definition of reality later in life.

2. Urban Minority Underclass Families

Since the family is a basic social institution, it is not surprising that interpretations of the state of families are loaded with value assumptions. Single-parent families, for example, are interpreted as "broken." In the larger context of American society, even the very definition of the family is subject to intense ideological debate.[4] We will not pretend to entirely escape such tangles, but we do assume the centrality of the family for the provision of a stable, caring, nurturing, and learning environment of children. We will look at the problems and strengths of the black family, starting with the situation of the underclass, which William Julius Wilson calls the truly disadvantaged.

Because of the lack of economic resources, the environment, and the lack of opportunity, children of the truly disadvantaged family are severely tested and at risk. The truly disadvantaged family belongs to the underclass which include individuals who

> lack training and skills and either experience long-term unemployment or are not members of the labor force, individuals who are engaged in street crime and other forms of aberrant behavior, and families that experience long-term spells of poverty and/or welfare dependency.[5]

It is important to note that long-term welfare families and street criminals are distinct groups. What makes them both part of the underclass is that they are the long term residents in the same depressed neighborhoods.6 Hence, children growing up in long-term welfare families will also interact routinely with street criminals--including drug dealers. Wilson calls attention to the fact that 60 percent of those in poverty experience a spell of poverty of eight or more years, and that families headed by women are likely to have even longer spells of poverty.7 So poverty and welfare dependency are often long term experiences, long enough to have a major impact on the formative years of a child's development. The length of the spells of poverty and welfare warrant the inclusion of families from this group in the urban inner city underclass.

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[4] Brigitte Berger & Peter L. Berger, The War over the Family: Capturing the Middle Ground, (New York, 1984), p. 59.

[5] William Julius Wilson, The Truly Disadvantaged, (Chicago, 1987), p. 8.

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According to Wilson, there are a spectrum of social dislocations which disproportionately affect blacks, including especially the black underclass. They include:

1. Blacks are disproportionately involved in violent crimes, where, for example, one out of two persons arrested for murder and negligent homicide were black. Such crimes are primarily intraracial, and they occur most intensely in the depressed communities of the underclass.8

2. There has been a dramatic increase in female-headed families in the black community from 25 percent in 1965 to 43 percent in 1984. These households are concentrated in metropolitan areas, are headed by younger women, and experience a median income of $7,999 as distinct from a median income of $21,840 for black families involving both a husband and wife.9

3. In 1983, 46 percent of black children under 18 resided in families below the poverty level, and 75 percent of those families had female heads-of-household.10

4. Out-of-wedlock births for black children were 15 percent of the total in 1959, and 57 percent of the total black births in 1982. Also, 89 percent of teenage births in 1983 were out-of-wedlock births. These percentages were even higher for Chicago.11

Wilson does not say much about drug abuse, and there is a need for much research on this subject. One survey concludes, however, that 40 percent of black high school seniors and 67 percent of dropouts have tried illicit drugs within a year's time. The use of intravenous drugs are one primary source of infection with the AIDS virus, with the risk higher for blacks. As blacks grow older, the drugs which are used--such as heroin--tend to have more severe addictive effects and are increasingly detrimental. While there are many explanations of the etiology of drug abuse, stress which is caused by social dislocations may be an important factor.12 In addition, we may speculate that drug abuse is likely to be interactive with other social dislocations, both

[6] Ibid., p. 8.
[7] Ibid., p. 10.
[8] Ibid., pp. 22-25, & 32.
[9] Ibid., pp.26-27.
[10] Ibid., pp. 26-27
[11] Ibid., p. 29.
[12] Beny J. Primm, "Drug Use: Special Implications for Black America," in The State of Black America 1987, (National Urban League, 1987), pp. 145-158.

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being as result of some and causing further dislocations. Drug abuse seems to be interactive with crime and joblessness in just this way.

Wilson explains these dislocations as due to a complex set of factors, including that because of historic racism (racism before the middle of the twentieth century) migrating rural blacks from the south were forced to concentrate in the central cities of the north. Unfortunately, he suggests, that unlike with smaller groups of Chinese and Japanese immigrants, the groups of migrating blacks were too large to be absorbed by special occupational niches in big city economies. Similar problems arose as the increase in the mechanization of agriculture pushed rural blacks toward central city areas in southern cities.13 Second, in 1984, the average age of blacks and Hispanics was much younger than that of whites. Hence, age-associated problems of crime, out-of-wedlock births, and welfare dependency were increased. These are age-associated problems because, as the numbers of teenagers who are jobless and not in school increase, so do delinquencey, crime, and unrest.14 Third, changes in economic structure in cities have been more intense than in other areas. In cities, the goods-producing activities have been replaced by information-processing activities, and that has created a mismatch between the educational attainment of many minority youth and available jobs. The magnitude of individuals experiencing such a mismatch ensured that many youth would never make a successful labor market adjustment. Similar problems have occurred with Hispanics.15 Fourth, working-class and middle-class blacks out-migrated from inner city areas, leaving behind pockets of extreme poverty. The result was that those left behind were the most disadvantaged and isolated from job networks through which they may learn about and receive recommendations for jobs. In its place, welfare dependency and the underground economy became a way of life for those who were jobless.16

Wilson notes that major changes have occurred in the structure of the black family, including a rise in female-headed households. He suggests the single most important factor explaining this change is the problem of male joblessness.17 This, he suggests, has led to a decrease in the pool of marriageable men. That is, the pool of black men who have stable employment has been shrinking, thus reducing the number of men young women might choose for marital partners.18 On the other hand, he suggests that while in real terms welfare benefits have been declining, there has been an increase in the female-headed families and out-of-wedlock births. Welfare dependency, then, does not explain these trends.19 Male joblessness, rather than

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13Ibid., p. 34.
14Ibid., pp. 37-39.
15Ibid., pp. 39-46.
16Ibid., pp. 46-58.
17Wilson, p. 73.
18Ibid., p. 75.
19Ibid., pp. 77-81.

welfare, best explains the dramatic increases in female-headed black families.

Wilson suggests that the way the ghetto youngster defines his or her social reality is very much tied up with routine everyday experiences in neighborhoods which have these characteristics. Such youngsters growing up in these pockets of extreme poverty would, therefore, perceive joblessness not as an aberrant phenomena but as a way of life. They would experience long term welfare dependency as a norm, and perceive the underground economy as an accepted mode of income. There would be an absence of experience of alternatives, such as married-couple families, working and professional families, and opportunities to view the connections between education and viable employment. The ghetto youngster would have little opportunity to learn of them in their everyday experience.[20] Such alternatives would not become part of the child's "taken-for-granted" definition of reality. And unless experiences of such alternatives have a powerful impact, the child would take them as more easily detachable secondary realities.[21]

Wilson tends to discount the significance of contemporary racism (racism which occurs after the middle of the twentieth century) as of primary importance in the explanation of the social dislocations of blacks.[22] Landry has argued, however, that blacks have been disproportionately excluded even from unskilled working class jobs available in cities, and that reference to changes in the structure of the urban economy does not explain such exclusion. He suggests that reference to occupational discrimination does.[23] He, therefore, attaches much greater weight than Wilson to contemporary racism as explaining the social dislocations of blacks in inner city areas. It seems reasonable to add that contemporary racism is one further significant ingredient in the explanation of the social dislocations of blacks. And the preoccupation of many blacks with the issues of racism reflects how important an ingredient this has become in their definition of reality. Both the perception of racism and its reality closes opportunities.

We should note that description of the underclass does not exhaust descriptions of the lower strata of the black population, including the inner city population. Other writers have emphasized that the working poor and the working non-poor ought to be distinguished from the underclass.[24] While there may be pockets in the inner city which are primarily populated by members of the underclass, there will be other communities in the inner city which have greater proportions of working poor and working non-poor. Wilson indicates that within the inner city there are areas with varying percentages of households below poverty level and varying percentages of unemployment.25 These appear to be increasingly concentrated in certain areas, as he suggests, but his categories do not distinguish those working poor who, although below the poverty line, still work and value school achievement. Hence, the ghetto youngster's definition of reality may not be exclusively of an underclass reality, for the perceptive youngster will observe the working poor and the working non-poor families as well. There will be a more complicated everyday experience from which the youngster defines his reality. Nevertheless, the everyday experience of mass joblessness must surely impact severely on the ghetto youngster's perception of the efficacy of the mainstream assumption of the connections of education and employment.

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[20] Ibid., pp. 56-57.

[21] Peter L. Berger & Thomas Luckman, The Social Construction of Reality, (New York, 1966), pp. 22-24 & 138.

[22] Wilson, p. 30.

[23] Bart Landry, The New Black Middle Class, (Berkeley, 1987), p. 226.

[24] Douglas Glasgow, "The Black Underclass in Perspective," in The State of Black America 1987, pp. 132-133.

Finally, while Wilson views the underclass as socially isolated, one study suggests that almost all children in the United States have access to television sets, and that black children exceeded other children in their television viewing time. TV viewing, especially heavy viewing, affects the socialization of children. Analyses of the content of TV shows, however, showed that they portrayed black characters as poor, jobless, and in low status jobs.26 Although this is not so with the Cosby show, there is a predominance of undesirable socialization influences in television content on black children. As regards jobs, the picture of jobs implicit in television viewing is not representative of the real world of jobs. Unfortunately, that is where children learn much of what they know about jobs, and black children who lack other sources of information are especially vulnerable to distorted views of the world of work. On the positive side, however, black childen in inner city depressed neighborhoods may get much information from TV which would otherwise be unavailable.27 So while black youngsters in these areas are not connected with job networks from which they learn about and receive recommendations for jobs, they do get impressions from television of the world of work, even if inaccurate ones. Their social isolation is not complete, and television may be one source of mainstream aspirations, as well as a source of frustration.

3. Race, Castelike Status, and School Achievement

We suggest that contemporary racism plays a significant role in the explanation of the social dislocations of the underclass. Racism does not merely concern the black underclass. It cuts across the various economic and social strata of the black American community. Ogbu has usefully characterized this in terms of the castelike minority status of black Americans. He says

25Wilson, pp. 51-54.

26Carolyn A. Stroman, "The Socialization Influence of Television on Black Children," in Journal of Black Stuties, Vol 15, No 1, pp. 79-86.

27Ibid., pp. 92-93.

> Castelike minorities are those who are incorporated into the country more less involuntarily and permanently and then relegated to menial positions through legal and extralegal devices...Membership in a castelike minority group is often acquired at birth and retained permanently. Its members are regarded and treated by the dominant white group as inferior and are ranked lower than whites as desirable neighbors, employees, workmates, and schoolmates. Castelike minorities lack political power, and this powerlessness is reinforced by economic subordination. Castelike minorities face a job ceiling. That is, they are not usually hired for jobs on the basis of training as members of the dominant group are; rather, their low-status group membership keeps them from being hired and being paid wages commensurate with their training and ability.[28]

The subordination of castelike minorities by the dominant group is rationalized by an overarching ideology of the dominant group. For their part, castelike minorities often develop the perspective that it is difficult for them to advance in the mainstream through individual effort and achievement. They do not think that mainstream standards of achievement and effort are applied to them. Whatever they do will not count because castelike status makes such standards inoperative for the dominated group.[29]

Because of the involuntary nature of castelike status, members of dominated groups not only view themselves as different from the dominant group, but are also in important ways opposed to the dominant group.[30] Minority youth may tend to view schools as white institutions, and treat the rules, standards of achievement, language, and curriculum of schools with the antagonism towards whites which they have internalized from their experience of castelike status. Even if they possess the requisite cognitive and language skills for school success, they may experience difficulty in school achievement because of this way of viewing the school.[31] The reason they may do this is that they identify the school with the dominant group, and so oppose themselves to its values. They will treat behavior oriented toward school success as "acting white."

Castelike minorities are part of a culture in which they experience their caste status, and so maintaining cultural boundardies within that culture becomes an important task. Ogbu suggests that because the cultural differences are stylistic differences (black dress, talk, walk, worship, and thinking) within the American culture, it becomes more difficult to cross these boundaries than it would be for those whose primary culture is different from American culture.32 It is too easy for one to become identified with the dominating group. A working poor family may be labeled "Uncle Tom" for its approximation to mainstream cultural styles and values, and identification with the values of schooling may be sufficient within a peer group to identify a minority child with the dominant white culture. It may be suggested that among black youngsters and between black adults and youngsters, there will be varying criteria for those cultural boundaries.

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[28] John Ogbu, "The Consequences of the American Caste System," in Ulric Neisser ed. The School Achievement of Minority Children, (New Jersey, 1986), pp. 27-28.

[29] Ibid., p. 28.

[30] John Ogbu, "Research Currents: Cultural-Ecological Influences on Minority School Learning," in Language Arts, Volume 62, Number 8, December 1985.

[31] Ibid., pp. 866.

Further work needs to be done on the patterns of how ghetto youngsters draw such boundaries. An important educational task may be to redraw cultural boundaries in ways that are not self-defeating. Included in such redefinition of cultural boundaries would be permission for the ghetto youngster to speak and act in ways which permit access to mainstream educational and employment institutions. If part of the ghetto youngster's definition of reality constricts such opportunities, then it needs to be altered to open them to him.

Ogbu's notion of castelike minority status adds an important ingredient to the explanation of the situation of black Americans, including the situation of the underclass. One wonders just what the situation is now? Landry has argued persuasively that in the late 1960's and 1970's there has emerged a new black middle class. He says,

> It is new because of the changed normative climate, a climate increasingly free of the violence, intimidation indignities, and social restrictions of the past.33

Landry goes on to suggest that now a black middle-class person may be an engineer, an accountant, a consultant, a government bureaucrat, or a middle range executive.34 It would appear that the mechanisms of subjugation indicated by Ogbu have diminished somewhat. Unlike the lower class inner-city resident, middle-class blacks are moving into occupational niches previously closed to them.

Landry is quick to point out that this does not mean the end of what Ogbu calls castelike status. In times of recession, when jobs are scarce, blacks have been disproportionately squeezed out of available jobs.35 So it is reasonable to conclude that while the forward push of the black middle-class is successfully challenging castelike restrictions, the castelike status of blacks has not yet disappeared. Nevertheless, that castelike restrictions can be successfully challenged by blacks is an encouraging development. The experience of those middle class blacks who have successfully challenged such restrictions must, therefore, be conveyed to those ghetto youngsters who will not

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32Ibid., pp. 866-867.
33Landry, p. 91.
34Ibid., p. 92.
35Ibid., p. 195.

otherwise include such new opportunities as part of their definition of reality.

Finally, this may be connected with our previous discussion of families. While Landry describes the social realities of upward mobility for middle class Black American families, this must be sharply distinguished from the inner city black youth's definition of those realities. To a large extent, the upwardly mobile black middle class family does not share the everyday experience of the inner city youth. These "striving families" (families which place a high value on achievement, make many sacrifices, and draw on every available resource to facilitate their children's education) may not be within the ghetto youngster's experience.[36]If ghetto youngsters define academic success as more appropriate for whites,[37] and if valuing such achievement is a key to striving families, then such youngsters will percieve doors to be closed which are neverthless open. If ghetto youngster's and families see such striving families as an option within the black experience, then many doors may be opened which would otherwise be closed.

4. Cultural Style and School Achievement

Reginald Clark suggests that structural and demographic characteristics have very limited value as indicators of the entire set of assumptions and activities of children and parents.[38] Whether mothers are young or whether households have limited incomes, he thinks, says little about the total cultural style of families, or whether the children from such families will have high achievement motivation. In fact, he provides evidence to suggest that motivation for high achievement had more to do with the "total cultural style" of the family than structural and demographic characteristics.[39] Clark, therefore, sets out to show that poor and single or two parent families can motivate their children for high achievement, or low achievement. The cultural style of the family makes the difference, not the poverty level or family structure.[40]

His findings show that students who are high achievers are groomed and trained for that role in the family. Clark characterizes this grooming and training as "sponsored independence." In such families, parents show interest and involvement with their child, consistently and regularly monitor the child's activities, ritualistically involve the child in educational activities such as reading, studying, writing, and creating. The parents explain things to their children and advise their children. They convey a sense of esteem for their children, and model behavior that they expect of them.[41] By contrast, parents in families of children who failed in school were either too permissive or authoritarian. They had limited involvement with their children, did not adequately monitor the child's activities, infrequently engaged in parent-child educational activities, and had inconsistent expectations and standards for responsible behavior. When they criticized their children, they conveyed a sense of the worthlessness of the child, and they were not good role models for the child.[42] These differences in the cultural style of families, then, were highly predictive of which children would succeed or fail in school.

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[36] Ibid., p. 96.

[37] Ogbu, "Research Currents: Cultural-Ecological Influences on Minority School Learning," p. 867.

[38] Reginald M. Clark, Family Life and School Achievement: Why Poor Black Children Succeed or Fail, (Chicago, 1983), pp. 1-3.

[39] Ibid., pp. 1-2.

[40] Ibid., p. 1-14.

Are his findings accurate? In a more recent study, several other researchers have confirmed the centrality of the impact of the home environment on school performance. Using what they term the HOME Inventory, these researchers found that responsiveness of parents and general emotional climate were positively correlated with academic achievement.[43] But these researchers also found that there were some differences between males and females. For males, there was a very significant correlation between task oriented classroom behavior, and the active stimulation of educational activity. On the other hand, while there was not a clear pattern of task orientation among females, the correlation of emotional climate and parental responsiveness with school performance was more significant than with males.[44] Finally, the highest correlations were with home environment and classroom behavior, as distinct from classroom performance.[45] One might surmise that one of the ways in which home environment contributes to school performance is through encouragement of classroom behavior which makes learning possible.

In another study, "low-readiness" mothers were urged to attempt some teaching tasks, but lacked the skills they needed to teach to their children. Also, mothers of these low achieving first graders tended to convey to them both the importance of school success and the suggestion that failure was a likely outcome. Though in the study these mothers engaged in didactic activity with their children, they appeared to be responding to the child's achievement problems rather than to the child's initiative in learning. On the other hand, "high-readiness" mothers were more supportive than directive of the child's activities, and school related activities were integrated into the flow of play activities. While low-readiness mothers were directive of children, high-readiness mothers were more supportive, allowing their children to take the lead in their

[41] Clark, pp. 2 & 111-112.

[42] Ibid., p. 2-3 & 190.

[43] Robert H. Bradley, Stephen L. Rock, Bettye M. Caldwell, Pandia T. Harris, and Holly M. Mamrick, "Home Environment and School Performance among Black Elementary School Children," in Journal of Negro Education, Vol. 56, No. 4, (1987), pp. 506.

[44] Ibid., p. 506-507.

[45] Ibid., p. 507.

activities.[46] The researchers found that children may play an active role in their own learning even in structured maternal teaching tasks, and that high-achieving children tended to take the lead in such activities. The author speculates that a key to the high-achievment motivation of the first graders was the perceived upward mobility of the mother.[47]

In another study of academically talented students, the evidence similarly suggests that the real aspirations and hopes of parents even in the face of hardships and barriers was an important correlate with high-achievement. But the study also showed that GPA is significantly related to the student's self-perception of academic ability.[48] Students take grades as a measure of the ability to succeed in school environments, and are therefore sensitive to what grades they get.

It may be suggested, then, that one of the "mechanisms" through which the home environment has a positive impact on school achievement is through the self-perception of the student. Students who were high-achievers displayed a positive self-concept, were task oriented, persevered in tasks, and were person oriented.[49] They had come to internalize the parental values and high expectations, and thought that they would realize them. In effect, the family exhibited norms appropriate to high achievement, and they made such norms part of their own frame of reference. There is good evidence to suggest, then, that high achieving children may come from the various economic strata of black families. Landry's "striving families" of the middle class may exist in lower economic strata as well, and single parent families may be "striving families." Such family expectations and cultural styles promote high achievement in black children. A key part of the ghetto youngster's definition of reality, then, may be the experience of and the legtimitation of this family pattern.

5. Upward Mobility, Downward Mobility, and Droping out

If society was a system of fair competition where the family cultural style paid off in terms of fair rewards for effort, then one might argue that what is needed is intervention in the families of low-achieving children. Alteration of the family cultural style would result in higher levels of achievement, and ultimately success in mainstream employment. Recent research, however, suggests otherwise. According to this view,

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[46] Diane Scott-Jones, "Mother-as-Teacher in the Families of High- and Low-Achieving Low-Income Black First-Graders," in Journal of Negro Education, Vol. 56, No. 1 (1987), pp. 32-33.

[47] Ibid., p. 34.

[48] Sukai Prom-Jackson, "Home Environment, Talented Minority Youth, and School Achievement," in Journal of Negro Education, Vol. 56, No. 1, (1987), pp. 118-120.

[49] Ibid., p. 120.

> Differential access to societal resources, discrimination, and inequities in opportunities...restrict structurally the opportunities certain individuals (or classes of individuals) have for upward mobility in the stratification system.50

The findings of this study were that young black adults 54 percent of whom had pursued their education beyond the high school nevertheless experienced a 39 percent unemployment rate. And those who were employed were often underemployed.51 While this group was a high achievement group, most found restricted opportunities for upward mobility in the employment structure.

These results only appear to contradict Landry's findings of a new black middle class. Rather, in some niches of the occupational structure, castelike restrictions are more elastic, and blacks are able to successfully challenge them. In other parts of the occupational structure, castelike restrictions are more rigid, making successful challenge difficult. Further, Epps has pointed out that one difference between high-achievement and low-achievement families is that low-achievement families perceive the opportunity structure to be closed, while high-achievement families perceive themselves as able to cope with the current exigencies of life.52It may be suggested, then, that family cultural style is interactive with perceived and real opportunity structures in the environment. A high-achievement family style may create opportunities where castelike, economic power, and other structural restrictions have some elasticity. And by virtue of the emphasis on achievement they would be most likely to benefit from new opportunities which open up. On the other hand, the increase by the larger society of real opportunities for black Americans may contribute to an increase in high achievement families.

Within a competitive society, however, the children of low-achievement families will tend to be static or even downwardly mobile because their adjustment to the perception of closed opportunities leaves them least prepared to take advantage of new opportunities in the mainstream. Since peer and street cultures are alternatives within the local environment of youngsters, low-achieving children from such families may seek these as alternatives to closed opportunities of mainstream academic and occupational success.

A striking finding is that preadolescent black children show lower school self-esteem, lower school performance, but higher peer self-esteem than white children.53 One hypothesis is that as they grow older, the values of these black children are more

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50Karen R. Wilson, "Explaining the Educational Attainment of Young Black Adults: Critical Family and Extra-Family Influences," in Journal of Negro Education, Vol. 56, No. 1, 1987, p. 75.

51Ibid., p. 69.

52Edgar G. Epps, "Foreword," in Clark, p. xii.

53Bruce R. Hare, "Structural Inequality and the Endangered Status of Black Youth," in Journal of Negro Education, Vol. 56, No. 1, (1987), p. 108.

influenced by peers than by other groups, including a strong sense of peer solidarity.54 There is a progressive shift from attachment to school values to attachment to peer values, and so achievement criteria shift from the academic criteria of the school culture to criteria appropriate to peer culture. Achievement becomes mastering street-wiseness, sexuality, having an income, childrearing, and taking on adult roles.55 The definition of reality gets altered in ways that practically ensure the lack of school achievement motivation.

This is the heart of the problem such youth confront. Mastery and achievement within the peer culture offers little hope of long term mainstream success. But these youth will devote time, energy, and commitment to this culture. Further, such peer cultures tend to be oppositional to schooling and school values. This is especially so where many of those who shift the locus of their definition of reality from school to peer cultures have experienced failure within schools. Where their families are characterized by unsponsored independence, such youth are not equiped to resist the temptations of peer culture, and where no father is present black male youth are most vulnerable to recruitment to a street culture. The reason is that such youth have a developmental need to break with their mother's control, and a peer culture offers a mechanism to do that.56 The peer culture is not necessarily equivalent to the culture of criminal and drug activity. Often, however, an inner-city youth shifts allegiance to peer culture, and runs a risk of downward mobility in criminal and drug activities.

Black teenage women, whose births are 87 percent out-of-wedlock, and who experience low-achievement in school, may see childbearing as a new opportunity for achievement. One study speculates that in the absence of other ways of achieving success these teen women shift their definition of reality to centrally emphasize womenhood and childbearing, thus achieving success within this new framework.57 But as has been suggested, teen women with out-of-wedlock children occupy a low economic level. While motherhood may constitute a kind of alternative success, the long term economic prospects of this adjustment are bleak. Where such teen mothers lack the traditional extended family and where they drop out of school, they will experience diminished opportunities to acquire a stock of knowledge and skills needed for survival and employment. The study reports that 50 percent of teen mothers do drop out of school, thus reducing the chances of occupational success. The study also makes clear that the teen pregnancy phenomenon itself may be a reaction to the reality and the perception of the reality of closed occupational opportunities.58

54Ibid., p. 108.

55Ibid., p. 109.

56Ibid., p. 105.

57Joyce A. Ladner, "Black Teenage Pregnancy: A Challenge for Educators," in Journal of Negro Education, Vol. 56, No. 1, (1987), pp. 54-55.

58Ibid., p. 55.

Crime, drugs, and teen pregnancy could be viewed as various ways of "dropping out" of the mainstream emphasis on academic achievement and occupational success. Schools are obviously very crucial in promoting or blocking this phenomenon. If schools make failure a norm, they will encourage youth to seek other frameworks in which they can be successful. But these other frameworks do not offer the hope of mainstream occupational success which is part of the aspiration of many of these youngsters. Inferior educational responses are devastating to the life chances of black children. Similarly, as indicated in Flint's discussion of minority youth employment prospects, the lack of real upwardly mobile employment opportunities deals a devastating blow to the life chances of these youth. Thus opportunities for employment and school success must be real and believable for these youngsters.

6. Definitions of Reality and Self-Concept

The perceptions of social reality of blacks includes recognition of the economic problem of impaired access to jobs--especially upwardly mobile jobs--and recognition of the job ceiling of castelike status. As black children develop, they gradually become aware of these social realities. Ogbu suggests that there are several different responses as these concern school performance.

1. Black children may become disillusioned about the real value of schooling. As a result, there is a lack of effort because there is a lack of optimism about the real value of effort. But this disillusionment is compatible with the traditional black value placed on education. The disillusionment concerns the belief that one's effort and achievements will not be rewarded. Hence, "What's the use of trying?"[59]

2. Black children may engage in survival strategies--alternative ways of achieving subsistence or advancing. These may include "blaming the system" rather than accepting personal responsibility, manipulative and compliant seeking of white patronage, and hustling as succeeding without following a work ethic. In each of these strategies, achieving advancement is not done through "normal" means, and does not contribute to the building of habits and traits of character which promote success. The strategy is to by-pass normal means through these strategies. In school, students following these strategies attempt to succeed without performing in ways expected by the norms of school conduct.[60]

3. Another response is to become suspicious and distrustful of schools--perceived as reproducing discriminatory patterns--and thus to engage in conflictual behavior with schools. There is a corresponding lack of identification with the schools' goals, standards, and pedagogy, thus making it difficult for the black child to maximize school performance.[61] STS education which

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[59] Ogbu, "Consequences of the American Caste System, pp. 46-47.
[60] Ibid., pp. 47-48.
[61] Ibid., pp. 48-49.

seeks to empower youth may be one way of combatting this tendency.

4. A final response involves perceiving the school's academic tasks as essentially white, and to resist participation in such tasks. Black children then feel that school performance is for whites but not for them. This is part of cultural inversion, as defining what is black in opposition to what is perceived as white.[62]

What lies behind all of these responses is a negative minority self-concept, which is the internalization of the assumptions of inferiority and lack of social and economic power inherent in a castelike system. It would be useful for educational purposes to comprehend this problem from a developmental standpoint. Children gradually develop cognitive and affective capacities, and the way ethnic and race characteristics are perceived depend on the level of capacity of the child. One study suggests that children begin to comprehend racial differences as early as age three.[63] But their categories are more inconsistent, undifferentiated, concrete, and idiosyncratic than those of adults. Educational responses to such children would have to be more experiential than conceptual.

According to Spencer, a prime developmental task of castelike minorities is to acquire a positive reference group identity in the context of caste status in the mainstream society. When that does not happen, patterns like "race dissonance" develop. Race dissonance may occur from "humanistic" parenting in which children are raised to have "human" values which in effect diminish the salience of race consciousness. As a result, black children will tend to identify with white mainstream preferences, while at the same time being underprepared to deal with caste issues. There is a dissonance between their race and the preference system they adopt which denigrates their race.[64] Of particular importance is the fact that in white culture "black" is associated with "bad," television conveys negative stereotypes of blacks, and blacks are assumed to be a homogenous and poor group.[65] Spencer advocates that there is a developmental need for achievement of a race pride, and this cannot happen without special efforts and strategies of parents and teachers. Race pride, she suggests, is a key source of resilience in the face of the double problems of low economic status and castelike job ceilings.[66]

Banks and Grambs suggest that most black children tend to have a negative self-concept, and find it difficult to believe that they are beautiful in the context of a racist society.[67]

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[62] Ibid., pp. 49-50.

[63] Patricia G. Ramsey, "Young Children's Thinking about Race Differences," in Phinney and Rotheram eds., Children's Ethnic Socialization, (Newbury Park, 1987), pp. 58-59.

[64] Margaret Beale Spencer, "Black Children's Ethnic Identity Formation: Risk and Resilience of Castelike Minorities," in Phinney and Rotheram eds., pp. 106-107.

[65] Ibid., pp. 112-113.

[66] Ibid., pp. 114-115.

[67] Banks and Grambs

On the other hand, other writers reject the "negative Black self-concept" hypothesis.[68] Cross takes up this issue and suggests that we distinguish between personal identity and reference group orientation, as two distinct areas of self-concept. Personal identity concerns such items as overall self-esteem, personality, and interpersonal competence, while reference group orientation concerns racial identity, race awareness, and race esteem.[69] He proposes that the two may vary somewhat independently of each other, and are often confused in discussions of race self-concept.[70] Hence, developmental task of achieving race pride is concerned with race identity through fixing a reference group.

Other writers conclude that biculturalism which may involve conflicts of cultural norms does not cause maladjustment or intense psychological stress in adolescents of minority cultures.[71] While it may be reasonable to hold that low esteem of a minority culture by a dominant group may cause minority group members to lower their esteem of their own culture,[72] this need not result in pathologically low self-esteem. Nevertheless, even if not pathological in a psychiatric sense, such low esteem of one's own culture would tend to perpetuate the problems of castelike status and low economic status. The importance of emphasizing the salience of race is that a critical mass of blacks who identify with black people and culture is needed for collective action,[73] including STS forms of citizen action. This is important for blacks in all economic strata.

On the other hand, because black children have their life chances tied in many ways to the American mainstream, Cross emphasizes the importance of their development of a bicultural reference group orientation.[74] This would include a black reference group orientation and a reference group orientation regarding the mainstream multiracial society. Without the former, black children would suffer the kind of negative black identity described by Banks, and without the latter, black children would find participation in the mainstream more difficult.

One implication for this is that educational emphasis needs to be placed more on the system of incentives of black youth rather than on self-esteem.[75] It may be suggested that incentives which are generated through improving the range of real

[68] Nancy L. Arney

[69] William E. Cross, Jr., "A Two-Factor Theory of Black Identity: Implications for the Study of Identity Development in Minority Children," in Phinney and Rotheram eds., pp. 121-122.

[70] Ibid., pp. 131-132.

[71] Dorreen A. Rosenthal, "Ethnic Identity Development in Adolescents," in Phinney and Rotheram, pp. 174-175.

[72] Ibid., p. 178.

[73] Ibid., pp. 127-133.

[74] Ibid., pp. 128-133.

[75] Ann C. Willig et al, "Sociocultural and Educational Correlates of Success-Failure Attributions and Evaluation Anxiety in the School Setting of Black, Hispanic, and Anglo Children," in American Educational Research Journal, Fall 1983, Vol. 20, No. 3, pp. 385-410.

options for such youth will be more effective in motivating achievement than merely trying to build up self-esteem. One should not psychologize problems which are cultural, economic, and social in nature.

It may be objected that this involves attributing the capacity for political thinking to children long before they have that capacity. But Coles has shown that children exhibit intuitive political thinking as early as the age of four.76 While such political thinking requires theoretical adjustments for the child's level of cognition and affective capacity, political thinking does occur in children. Coles suggests that the political sophistication of black children concerning race relations is very advanced as early as the age of ten.77 Cole adds that the poor and the racially excluded have a way of holding on to their earliest impressions and treating them as reference points in their definitions of reality much later in their lives.78 Very clearly, the early experiences regarding race pride and race identity are crucial to the developmental history of political loyalties of the black child.

In adolescence, an individual is in a transitional period between childlike and adultlike ways. At this stage the adolescent has the capacity to think beyond concrete reality to hypothetical situations.79 Since decisions in this period have much to do with shaping the overall identity of the adolescent, the ethnic dimension of that identity is crucially shaped in that period. This may include developing a sense of cultural history, a sense of one's people, a sense of ethnic boundaries, and values as legitimated by one's culture,80 as a cultural basis for political and citizen action. Language becomes a mode of structuring and interpreting events and experiences, and ethnic identity is linked to linguistic symbols.81 One ethnographic study shows how white labels for blacks reveal a derogatory connotation--with the exception of "militant." Black labels for whites reveal a primary concern for those whites who are racist and those who are not. Black labels for blacks are concerned with solidarity among blacks, as well as with who "acts white" and who does not.82 In this stage it is particularly important that the adolescent find some new synthesis of his racial identity and bicultural orientation. The STS focus on the cultural dimension of technology and society may facilitate finding such an orientation.

As has been suggested, some of the existing syntheses for the black ghetto youngster tend to be self-defeating. Perhaps these syntheses may be altered by encourage of ethnographic studies by

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76Robert Coles, The Political Life of Children, (Boston, 1986), p. 27.

77Ibid., p. 30.

78Ibid., p. 49.

79Ibid., p. 157.

80pp. 157-159.

81Ibid., p. 163.

82Thomas Kochman, "The Ethnic Component of Black Language and Culture," in Phinney and Rotheram eds., pp. 225-228.

students of their own language. By such methods students may be encouraged to alter their particular synthesis to improve their own options. They would be altering their definition of reality through becoming more conscious of the terms which are key to defining their current definitions of reality.

Conclusion

We need to look at the situation of the black ghetto youngster from a variety of perspectives, each contributing to a holistic understanding. The inner-city crime, high teen pregnancy, poverty, drug abuse, and other dislocations can be viewed as resulting from historic and contemporary forms of racism, young average age of the inner-city population, changes in the city economic structure, and changes in the demographics of inner-city residents. Central to this is the problem of joblessness, which has resulted in a rise of female-headed families. But joblessness must also be understood in the context of the castelike status of black inner-city residents.

Given this situation, it is important--as Landry and Clark have done--to find rays of optimism. Landry finds these in the striving families which struggle to find a place in the middle-class, while Clark finds it in the inner-city family which facilitates school achievement of inner-city youth. Without such sources of hope, alienation from school and downward mobility are real possibilities. Schools play a pivotal role in overcoming this alienation, often in battle with a drug culture which encourages downward mobility or crime.

The black child defines his or her social reality from what he or she experiences in family, peer culture, school, and on television. These children need to develop a positive reference group identity, a sense of race pride, a sense of history, and a bicultural understanding which enables them to view schooling as contributing positively to their life chances. STS education approaches provide the opportunity to empower such children rather than to alienate them. Understanding the social realities and the child's definition of those realities is an important step in making STS education serve that empowering role.

INNER-CITY HISPANICS IN THE NORTHEAST: A SURVEY OF ISSUES RELEVANT TO STS EDUCATION

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Introduction

The problems affecting the inner-city as a whole have a similar origin and have to be approached from a unified perspective. It is not my intention to present a "Hispanic only" view of the problem but rather to complete the picture presented by other authors in this report (Stewart, Flint, Thomas, etc.) by providing some relevant information about a community whose particular characteristics are often ignored, or "lost" in more comprehensive studies of the inner-city. Addressing the particular characteristics of these communities will make it possible to approach STS education for Hispanics in a way that recognizes their peculiarities while providing a holistic explanation of the problems of the inner city as well as unified ways of action.

Hispanics in the Mainland: General Characteristics

Hispanics are the second largest minority and the fastest growing population in the United States. In 1985 the total Hispanic population in the mainland U.S. was 16.9 million; between 1980 and 1985 the Hispanic population increased by 16%, versus 3.3% for the overall population. Hispanics are also the youngest group in the nation. Their median age is 25.1 years versus 30 in the population as a whole. About half of the Hispanic population live in California and Texas, but there are also large concentrations in New York, New Jersey, Florida, Illinois, New Mexico, Arizona and Colorado (McKay, 1986).

Although they share important characteristics--use of Spanish as the vernacular, strong family ties and strong Catholic tradition--Hispanics are not a homogeneous group:

o About 60% are Mexican-Americans, most of whom are descendents of those who lived in the West and Southwest when these territories were annexed to the United States in 1846. Cultural maintenance among Mexican-Americans has been possible in part thanks to the continuous migration of Mexicans to the United States in later periods.

- Approximately 14% of the mainland Hispanic population are Puerto Ricans. They gained their citizenship in 1917 but began to migrate after the World War II. Because their main purpose was to improve their standard of living and return home, they have made efforts to preserve their traditions and keep contact with their families on the island.

- Cubans account for 6% of mainland Hispanic populations and came to the United States because of political reasons. The Cubans who migrated in 1960 belonged to the upper and middle class and held leadership positions in their country. Their economic status is generally higher than that of any other Hispanic group.

- The remaining 20%, defined as "other Hispanics", come from Central and South America and a large number of them do not hold US citizenship (Burgos-Sasscer, 1987; Duran, 1983).

About 87% of Hispanics live in urban areas, 60% in cities with populations of more than one million. Most Cubans and Puerto Ricans (97%) live within metropolitan areas, Puerto Ricans being the more metropolitan group. Since poor Hispanic communities in the Northeast are predominantly Puerto Rican, this paper focuses mainly on this group. The socio-economic problems of Puerto Ricans, as well as relevant cultural characteristics, are shared by other Hispanics living in the inner-city.

Inner-City Hispanics in the Northeast

Standard of living

Approximately 75% of all mainland Puerto Ricans are concentrated in American inner-cities (Perez, 1985). Half of the group's total population live in New York state, and the vast majority of these are concentrated in the New York SMSA. About 12% live in New Jersey and a significant number live in Chicago, Philadelphia and Boston (Congress of the U.S., 1986).

In 1984, more than 37% of Hispanics in the Northeast lived below the poverty line. Puerto Ricans showed the highest poverty rate: 41% were poor, compared with 24.1% Mexican-Americans, 23.6% Central and South Americans and

12.9% Cubans (McKay, 1986). About 50.5% Puerto Rican families had an annual income below $10,000 and half of them (23.5%) made less than $5,000 (National Commission on Secondary Education for Hispanics, 1984). The poverty rate for Hispanic families had not changed in 1986, but because of the population growth, the number of Hispanic families below the poverty line in 1986 was 24% higher than in 1981. Poverty levels are especially high in female-headed households, and approximately 44% of Puerto Rican children live in single female- headed households (Bureau of Census, 1987).

At the national level, only 15% of Puerto Ricans own their homes. The percentage is higher only in some areas of the Midwest, where 33% of Puerto Ricans are home owners. The 1983 study by the U.S. Department of Housing and Development showed that approximately one-third of all Hispanic households lived in physically inadequate or overcrowded housing, compared with 10% of white households. Puerto Ricans and other poor Hispanics remain concentrated in inner-city neighborhoods, faced with deteriorating housing, increasing housing shortages and rising rents. The situation worsened at the end of the 70s and early 80s, because of a wave of arson that ravaged ghettos across the nation (Perez, 1985).

Studies reported by Perez (1985), suggest that the most important health issues in Puerto Rican communities are mental health, substance abuse--both aggravated by unemployment--environmental conditions, and perinatal and infant mortality. Most (90%) of the 133,440 Hispanic drug-abusers in the state of New York were Puerto Ricans. Puerto Ricans in New York have higher death rates from heart disease, diabetes and cirrhosis of the liver than the rest of the population. Children under 15 years of age have disproportionate death rates from bronchitis, influenza and pneumonia. Lack of food, inappropriate or absent medical attention, and poor housing conditions aggravate the problems.

In addition to this, toxic waste poses serious threats to poor communities in the inner-city. As Perez points out,

> most of this poisonous, cancer-causing waste is dumped in powerless communities, communities not controlled by their residents--like the Ironbound District in Newark, Pelham Bay Park in the Bronx.... Of the 812 toxic waste dumps on the Environmental Protection Agency "national priority list" (of high risk sites) 301, about 37% are in the Northeast (including New York, New Jersey and Pennsylvania. 97 of them, 12% are in New Jersey (p.5).

Employment and occupational-related problems

Only 53% of all Puerto Ricans over 16 were working in 1987 (Bureau of Census, 1987), and Hispanics as a group are highly subject to underemployment (Perez, 1985). Hispanics are underrepresented at the upper end of the occupational scale and overrepresented in lesser skills occupations.

While Mexican-Americans have the lowest percentage of professional workers, Puerto Ricans have the lowest proportion of managers (Congress of the United States, 1986). According to data from the Bureau of Census (1987), 33.8% of employed Puerto Rican males worked as operators, fabricators and laborers, 21.6% as technical and administrative support, 15.8% as precision production, craft and repair workers and 14.9% in service occupations. As for females, 50% worked as technical, administrative and sales support and 18.9% in service occupations. In general, Puerto Ricans are less likely to have white-collar and higher paying jobs and more likely to be in blue collar and service jobs in declining industries.

Automation has been and will continue to be more significant as a displacement factor for Puerto Ricans than for any other group. First, profound industrial and occupational changes have taken place in the US cities where Puerto Ricans are concentrated. A crucial aspect of these changes is that the kinds of industries that are expanding and the types of jobs that are being created call for highly educated workers at a time when Puerto Ricans have the country's highest dropout rate and the lowest rate of educational attainment.

Secondly, because of their socio-economic position Puerto Ricans are bound to be among the first fired and their lack of preparation makes it difficult for them to occupy alternative spaces in the changing job market. As a 1985 report from the US Congress points out,

> The combination of a shifting economy with the relative deterioration of the educational status of this group threatens to freeze Hispanics in the critical stage of their migratory experience. Historically, blue collar, farm and clerical jobs have served as take-off points for immigrants. However, given the changes in the job structure and the lack of any real advancement by Hispanics in education during the last 20 years, it is uncertain, at best, whether Hispanics will be able to climb up the socio-economic ladder. (Congress of the U.S., 1985, p.23).

Political participation

Our full understanding of the political world of Hispanics is hampered by the lack of basic information about Hispanic electoral and communal/organizational activity (e.g. formally and informally defined organizations, national groups, grass-root, etc.). Research in this direction is a condition necessary to develop a comprehensive approach to Hispanic political participation. In addition to data gathering efforts, research should emphasize the role of family and the schools in influencing Hispanic participation, studies of how Hispanics influence policy and become participants in policy-making environments and settings and studies of the role played by non-Hispanic elites in shaping Hispanic involvement in the political process (Institute for Puerto Rican Policy, 1984; McKay, 1984).

Available data indicates that Hispanic voter participation tends to be lower that that of Blacks and White non-Hispanics. Approximately 48% of eligible Hispanics voted in the 1984 presidential elections, as compared with 64% Whites and 58% Blacks (McKay, 1986). Between 1982 and 1983, predominantly Hispanic assembly districts in New York City showed the largest percentage of increase of registered voters--approximately 26% compared with 15% for Blacks, 6% for Whites and 8% citywide. However, Hispanics still remain the group with the lowest voter registration in the city (Perez, 1985). If participation in national elections is taken, as Burnham (1984) does, as an indicator of "civic inclusion"--or the ability to participate in a democratic society--it can then be said that inner-city Hispanic communities are, at best, at the fringes of the democratic process. It has been argued that the existence of "a culture of poverty" acts as an effective barrier to civic inclusion (Eckstein, 1984). According to Lewis, this culture reflects the combined effect of a variety of factors, including poverty, but also segregation and discrimination, fear, suspicion, apathy, all of which prevent the development of alternative institutions and procedures in the slum communities.

The "culture of poverty" will remain an obstacle to participation in the democratic process as long as the the price for civic inclusion appears to be the assimilation to the middle class and its values, a price that is economically, psychologically, and structurally beyond the means of the poor (Burnham, 1984). However, political power must be on the agenda if inner-city Hispanics want to change their present situation. Faced with deteriorating socio-economic conditions and cutbacks in Federal programs, existing and new grass-root organizations must engage in political activity aimed at developing institutions to safeguard the community's democratic rights, defend existing institutions that serve the community, develop the ability to build unities with other groups in the inner-city, and develop the power to influence national policy. Full participation of Hispanics also requires increased voter participation as well as political education. This new electoral power must encourage mass community campaigns that strengthen the independent organization of the communities (McKay, 1986; National Council of La Raza, 1984). As Burnham (1984) suggests, the choice seems to be between civic inclusion of the inner-city communities "on their own existential terms mobilized by their own organizations, or no civic inclusion at all" (p. 159).

Problems in inner-city Hispanic education

In general, research on the educational situation of Hispanic students shows that this group is getting less academic preparation than white non-minority groups (Duran, 1983). The national dropout rate among Mexican-Americans and Puerto Ricans is between 40% and 50%, compared with 14% for whites and 35% for Blacks. Dropout rates are as high as 80% in New York, 70% in Los Angeles and 50% in Chicago (National Commission on Secondary Education for Hispanics, 1984). Among the population over 25 years of age, 53% have four years of high school and only 8% have four or more years of college (Bureau of Census, 1987).

Over two-thirds of Hispanic students attend schools where more than 50% of the students are minority (National Commission on Secondary Education for Hispanics 1984). A 1985 study of the State of New York showed that, of the total 391,443 Hispanic students in the state, 308,534 (86.5%) attended school in New York city and 48.3% of them attended schools with more than 50% Hispanic enrollment (New York Department of Education, 1985). Due to housing patterns this de facto segregation is not likely to change in the near future.

Inner-city schools tend to be overcrowded, poorly equipped, and have the lowest levels of service and the least experienced teachers. Most Hispanic students are not in strong academic programs but clustered in what are called general and vocational courses (National Commission on Secondary Education for Hispanics 1984). Counselor-student ratio is 1/700, versus the 1/250 recommended. The quality of classroom interaction in these schools is poor in part because counselors and teachers tend to have lower expectations regarding inner-city minority students (Perez, 1985).

Many teachers and principals view Puerto Ricans in terms of prevailing prejudices (dirty, wiry, treacherous, aggressive, 'spics', and so on). Schools with a large Puerto Rican enrollment have become "difficult" in view of teachers and urban boards of education. Classes are heavily weighted with transients, with children from broken homes and with "problem students"; teachers are reluctant to teach in these schools. As a result these schools are unable to attract enough qualified teachers and have high rates of teacher transfers and resignation (Cardasco & Bucchioni, 1982). Psychological assessment, has played the role of legitimating a bias regarding the minority student, since children's difficulties are often attributed to psychological dysfunctions of the student without considering other factors (e.g. curriculum, exclusionary orientation of teachers towards minority students, particular teaching methods, and so on) (Cummings, 1986).

For Perez (1985), the factors contributing to high dropout rate among Puerto Ricans are the lack of bilingual programs in public schools, the schools' unresponsiveness to the students' cultural backgrounds, the continued use of IQ and standardized tests originally designed for white middle-class students, the dumping of students into special education, the belief that Puerto Rican students are "uneducable," and the lack of bilingual and peer counseling as well as the lack of Puerto Rican administrators, teachers and paraprofessionals. Any explanation of the dropout problem is incomplete if external factors are not taken into consideration. Because of financial hardship in the family, Puerto Rican and poor Hispanic students may have to work full-time. In 1980, Hispanic male students were more likely than Anglo, or Black male students to hold full-time jobs and they averaged more hours of work per week while attending school (National Commission on Secondary Education for Hispanics 1984). It has been suggested that the propensity among Hispanics to assign priority to the well-being of the family may have an unintended negative impact on school performance, because Hispanic youngsters are more affected by family problems than any other group in society (Duran, 1983).

The 1980 High School and Beyond study showed that 70% of the Hispanics tested at the bottom half of national achievement tests. Between 1975 and 1983 Mexican-Americans' combined SAT scores decreased an average of 11 points, from 792 to 781; Puerto Rican students' scores decreased from 765 to 761, an average of 4 points. The scores may have risen in recent years, but the number of students taking the tests has decreased dramatically (National Commission on Secondary Education for Hispanics, 1984).

Language has been often used as a framework to explain Hispanic failure in the school system. Whether they are born on the island or in the mainland U.S., 90% of Puerto Ricans are estimated to have Spanish as a native language (Duran, 1983). Research in East Harlem in New York shows that although young Puerto Ricans tend to prefer English, they often mix Spanish and English when talking with peers. The relatively stable set of rules used by those mixing the languages suggests that they have knowledge of both morphological and syntactical rules of both languages. It could be concluded, then, that the poor writing skills in essay organization of many Hispanic students reflect the lack of higher level skills in essay organization and poor literacy training rather than language deficiencies connected to the use of Spanish at home or the transfer of Spanish structures into English. There is a correlation between low achievement, dropout and language difficulty but other intervening variables must be taken into consideration. According to Duran (1983),

> ...factors other than language difficulties contribute better to retention [and success] of Puerto Ricans in schools: communication with parents, parental guidance and support, presence of significant adults at schools, knowledge and pride in Puerto Rican heritage, perceptions of broader societal opportunities and student professional and higher education goals. (p.29)

Thus, language background cannot be used as the sole explanatory, or even the most important one, for the failure of Hispanics in schools. According to Walsh (1987), research has shown that when children develop strong academic skills--specially those related to literacy--in their first language, these skills are easy to transfer to the second language. Schools should then encourage the development of basic skills in the native language. This effort is necessary to fight the increasing lack of linguistic identity among Hispanic youngsters: Inner-city interactions have created a wide array of language varieties that can seldom be defined as only Spanish or only English in orientation.

High dropout rates, low grade point average and scores in college admission examination tests and increasing costs explain why only 4.5% of all college and university students in the United States are Hispanic. Although there have been increases in the overall number of Hispanics who have earned a higher education degree, the proportion is still very low when compared with the white non-Hispanic student population: In 1980, Hispanics received 2.3% of the baccalaureates, 2.2% of the master's, 1.4% of the doctorates and 2.2% of first professional degrees conferred

(Burgos-Sasscer, 1987). As Perez (1983) puts it, government figures indicate that only half of the 55% of Puerto Rican high school graduates eligible to go to college actually enroll in higher education. Of those who do, only 28% will graduate. In other words, "if we start with a hypothetical 100 Puerto Rican students, the best-case scenario has 55 graduating from high school, 25 entering college and 7 graduating from college" (p.5).

The point of entry to higher education for over 60% of Hispanic students is the community college. Since only 10% of all community colleges students transfer to senior institutions, it has been suggested that these institutions work against Hispanic educational achievement (Burgos-Sasscer, 1987). Although community colleges no longer engage in the "cooling out" of minority students, "there is a tendency towards tracking academically unprepared students away from pursuing baccalaureate degrees" (p. 28). Moreover, Hispanic students are not being prepared for those careers that provide access to upward mobility. Hispanics are overrepresented in the social sciences, the humanities and education and underrepresented in the physical sciences, engineering, and business (Astin, 1982). The same pattern occurs in graduate programs. In 1980, only 2.4% of all graduate students were Hispanics; in June 1986, only 30 of the 399 institutions awarding doctoral degrees awarded Ph.D's to Hispanics (Burgos-Sasscer, 1987).

Implications for STS education

According to Waks (1988, p. 1) "the goals of STS education are to promote scientific and technological literacy in order to empower citizen participation in democratic decision making and action processes to resolve the pressing technologically-dominated problems of our late industrial society." Underlying this definition is the understanding of science and technology as a social process, whose evolution depends upon the interests and intentions of real people, acting in given social and political settings. Thus, STS education can be seen as part of the movement towards improving the quality of education, but, most importantly, of a movement aimed at gaining and maintaining the democratic control over scientific and technological decisions that affect the life of the entire community. These two purposes are of particular importance in the context of the inner-city Hispanic communities who, as we have seen, get the least from the educational system and are typically marginal or "excluded" from the civic society. These problems are common to all the groups which comprise the inner-city population. My remarks on STS education address some of the particular characteristics of the inner-city Hispanic communities and are aimed at "completing the picture" presented by other authors in this report, rather than at providing an alternative or exclusive set of guidelines.

In order to make a difference in the inner-city environment, STS education must focus on issues of immediate significance for the inner-city community. Because issues such as toxic waste and drug-abuse, among others, are relevant to all the inhabitants of depressed urban areas, it is important that they are presented as problems of the inner-city and not as problems of particular groups within it. STS education must also enhance the academic experience of Hispanic students, in a way that they are given access to the best possible education, one that makes possible the development of the basic, general skills required for a full understanding of the problems of science and technology and the way they affect the students' daily lives and their environment. As expressed by White (in Aronwitz & Giroux, 1985, p.155-6), the school curriculum

> ought to be one which lays the basis for increasing the ability of as many students as possible to become active, participating adults. [Students must] learn some real skills and knowledge which allow them to take part in adding to the general social good and also gain the basis for making judgements about undesirable social directions.

A stronger educational background should also help inner-city Hispanic youth overcome the difficulties associated with finding jobs and moving both horizontally and vertically along the occupational structures characteristic of the post-industrial society. Although the solution of problems of unemployment and underemployment is well beyond the possibilities of the educational system, schools can make a contribution to the career preparation of Hispanic students by (a) equipping them with better knowledge and skills, and (b) providing them with an understanding of the changing nature of the contemporary world of work as well as of the possibilities of "alternative worlds of work" available to them outside the formal occupational ladder (see Flint, in this report).

Since political participation is an important component of the STS education proposal, a final point has to be made regarding the way in which schools can contribute to the political socialization of the inner-city Hispanic youth. Civic inclusion, or the ability to "effectively and intelligently participate in a democratic society" is one of the most important aims of the American educational system (Social Science Education Consortium, 1984). The political apathy that often characterizes inner-city communities can be taken as an indicator of the extent to which schools fail to integrate minority students into the "civic society."

De facto civic exclusion has been explained by Giroux (1983) as the result of an overemphasis, within the school system, on competition and individual achievement. Students do have equal access to the educational system but their civic exclusion remains differential: By tacitly or explicitly conveying to students values, believes and social practices whose "universal validity" is taken for granted, schools deny the value of different subcultures within the society. By failing those who, for different reasons, do not assimilate those values, schools contribute to their exclusion from the civic society (Walsh, 1987). School failure or negative experiences suffered by children in the classroom, according to McDermott and Gospondinoff (in Walsh, 1987), are one of the causes of the ethnic solidarity that appears in inner-city schools as a reaction against overt or hidden school practices. Schools are perceived as middle-class institutions and their practices "resisted" by minority groups, by way of deviant or oppositional behavior and academic failure.

This resistance can be interpreted as cultural inadequacy, inability to cope, or merely as a disciplinary problem. But it can also be interpreted as the manifestation of a strong group/ethnic identity through which students express their discomfort with a given state of affairs. In the case of inner-city Hispanic youth, this form of solidarity can even be seen as the basis upon which to build a true citizenship education. A pedagogy that takes resistance and ethnic solidarity as a starting point can become a constructive pedagogy if the cultural experience of the inner-city communities is rescued, integrated to the school curriculum in a way that interrogate them critically about the strengths and weaknesses of that experience. According to Aronwitz and Giroux (1985), this approach is

> based on a dialectical notion of what counts as really useful knowledge and school practice in the building of an emancipatory curriculum. It would be developed around knowledge forms that challenge and critically appropriate dominant ideologies, rather than simply rejecting them outright; it would also take the historical and social particularities of students' experiences as a starting point to develop a critical classroom pedagogy (p.217).

While it could be argued that these are, or ought to be, the purposes of education, of which STS education is but one component, the STS education proposal does represent an alternative to revitalize the public school. STS education emphasizes both contents and process and give priority to participation and active involvement in the life of the society. In so doing, the STS the curriculum proposal gives new meaning to the ideals of citizenship education in connection with the serious problems affecting entire communities and not particular individuals. It lays the basis for a curriculum that provide "the skills which are basic, now, to a class that means to lead, not simply to serve, the modern world" (Hall, in Aronwitz & Giroux, 1985, p.217).

References

Aronwitz, S & Giroux, H.A. (1985). Education under siege. The conservative, liberal and radical debate over schooling. South Hadley, Mass: Bergin & Garvey.

Astin, A. (1982). Minorities in Higher Education. San Francisco: Jossey Bass.

Bureau of Census. (1987). The Hispanic population in the United States: March 1986 and 1987 (Advance Report). Suitland, Md.: Bureau of Census Population Division. ERIC Document 286696.

Burgos-Sasscer, R. (1987). Empowering Hispanic students: A prerequisite is adequate data. Journal of Educational Equity and Leadership, 7(1), 21-36.

Burnham, W.D. (1984). A commentary on Harry Eckstein. Daedalus, 113,147-160.

Cardasco, F. & Bucchioni, E. (Eds.) (1982). The Puerto Rican Community and its children on the Mainland: A sourcebook for teachers, social workers and other professionals. Metuchen: New Jersey: The Scarecrow Press.

Congress of the U.S. (1985) Statistical report on Hispanic access to higher education. Washington DC: House Committee on Education and Labor. ERIC Document ED266716.

Congress of the U.S. (1986). Selected demographic characteristics of the U.S. Hispanic population. Washington DC: House Committee on Post Office and Civil Service. ERIC Document ED274759.

Cummings, J. Empowering minority students: A framework for intervention. Harvard Educational Review, 56(1), 18-36.

Duran, R.O (1983). Hispanics education and background: Predictors of college achievement. New York: College Entrance Examination Board. ERIC Document ED230665.

Eckstein, H. (1984). Civic inclusion and its discontents. Daedalus, 113, 107-145.

Giroux, H.A. (1983). Theory and resistance in education: A pedagogy for opposition. South Hadley, Mass: Bergin & Garvey.

Institute for Puerto Rican Policy. (1984). The public policy research and the Hispanic community: Recommendations from five task forces. New York, N.Y. ERIC Document ED256056.

Lewis, O. (1982) Culture of poverty. In F. Cardasco & E Bucchioni (Eds.), The Puerto Rican Community and its children on the Mainland: A sourcebook for teachers, social workers and other professionals (pp. 72-81). Metuchen: New Jersey: The Scarecrow Press.

McKay, E.G. (1984, Feb.). Recent Hispanic Polls: A summary of results. Washington DC: National Council of La Raza. ERIC Document 242812.

McKay, E.G. (1986). Hispanic demographics: Looking ahead. Washington DC: National Council of La Raza. ERIC Document ED274754.

National Commission on Secondary Education for Hispanics. (1984). Make something Happen: Hispanics and Urban High School Reform. Vol I. New York: Hispanic Development Project Inc.

National Council of La Raza. (1984). We mutually pledge: Proceedings of the Third National Hispanic Leadership Conference Washington DC. ERIC Document 250439.

New York Department of Education. (1985). Racial/Ethnic distribution of public school students and staff, New York state, 1984-1985. Author: Information Center on Education. ERIC Document ED266223.

Perez, R. (1985 June). The status of of Puerto Ricans in the United States. Paper presented at the National Puerto Rican Convention, Philadelphia PA. ERIC Document ED273711.

Social Science Education Consortium. (1984). Science, Technology and Society: A framework for curriculum reform in secondary school Science and Social Studies.

Boulder: Author.

Waks, L.J. (1988) Critical theory and curriculum practice in STS education. Unpublished paper. The Pennsylvania State University.

Walsh, C.E. (1987). Schooling and the civic exclusion of the Latinos: Towards a discourse of dissonance. Journal of Education, 169(2), 115-131.

SCIENCE EDUCATION FOR URBAN MINORITY STUDENTS-CURRENT PROBLEMS AND POTENTIAL SOLUTIONS

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The curriculum in use in American urban schools fails to reflect the realities of everyday life in the city. This can be easily seen by any visitor to an urban school. Gerald Unks (1984: 443) has eloquently written: "The urban curriculum - even at its best - has usually worn a pair of bib overalls. Its shape resembles the barn, the chicken coop, and the silo more than the museum, the traffic jam, or the skyscraper. The irony is understandable in the context of American history, for the idea of cities was never part of the grand Jeffersonian plan for the new Zion". As urbanization continues in America, the gap between the outer world and the world of the urban school widens. This paper considers the nature of that gap and some causes for its increasing growth. It will propose some alterations to what we do in urban schools, particularly in science education. Getting a firm grasp of the problem requires an overview of the nature, extent, and effect of science education at the precollege level, science achievement of subgroups of American students, and the effects of the urban environment on the schooling process.

This paper will focus primarily on the minority populations of the Northeast section of America. Findings that emerge from this study will only be generalizable to areas with characteristics similar to this region of the nation. The premise of this paper is that Science, Technology, and Society education (STS) at the precollege level can play a useful role in adjusting science education more appropriately to the needs and demands of urban students.

OUR CITIES AT RISK

National task forces and blue-ribbon committees of science educators, university professors, business leaders, and science and technology practitioners have issued numerous reports in recent years about the state of science education in the United States. The 1980 report of the Carter Administration entitled "Science and Engineering Education for the 1980's and Beyond" was one of the first to point to a new emerging crisis in science education in America. This was followed in 1983 by "A Nation at Risk", the 1985 Carnegie Report on American high schools, and many other reports whose ominous titles alone warned readers of a major crisis in U.S. science education. The professional body of science educators, The National Science Teachers Association, joined the critics by devoting their 1983 yearbook to an explication and analysis of the crisis (Brown and Butts, 1983; Lockard, 1985).

A recent study of precollege science achievement of American youths versus their counterparts in sixteen other nations reinforces these conclusions (Research Triangle Institute, 1988; Rothman, 1988a; Walsh, 1988). Nations chosen for this study were: Australia, Canada, Great Britain, Finland, Hong Kong, Hungary, Italy, Japan, South Korea, the Netherlands, Norway, the Philippines, Poland, Singapore, Sweden, Thailand, and the USA. U.S. fourth and fifth grade students ranked below half the other nations in science achievement. Results in upper grades were even worse. In the twelfth grade, only U.S. students taking a second year biology, chemistry, or physics class (e.g. an advanced placement course) were compared with their counterparts so the results are even more disturbing.

Some other conclusions from these studies were that teachers in mathematics and science education at the precollege level are apt to be underprepared in the specific content areas they are teaching. There is a critical shortage of qualified math and science teachers at precollege levels. American students going on to universities are electing science, engineering, and mathematics fields less frequently. Pursuit of a doctorate in these fields by American citizens is on the decline. Foreign students are filling the undergraduate and graduate classroom, while foreigners are occupying increasing numbers of faculty positions in these fields. Finally, students at all levels within our educational system take the absolute minimum number of science and math courses required for graduation from that particular level of the system. There is a pervasive feeling throughout these reports that in the midst of an increasing technological and scientifically oriented culture, Americans are losing their understanding of the very technological and scientific principles and processes exemplified in artifacts of our everyday lives. Even the National Task Force on Citizenship Education, composed largely of social scientists and humanists, pointed out in 1977 that technological and scientific literacy was essential to responsible democracy (Brown, 1977).

Never explicit in any of these reports was the pervasive lack of achievement in our urban schools. While the nation may be at risk, our cities are at even greater risk. This is particularly true of minority students in our urban schools, and it is to this group we now turn.

MINORITIES IN URBAN SCHOOLS - DEMOGRAPHICS AND RISKS

The percentage of the U.S. population living in various areas has been shifting in clear-cut directions over the last two decades (Marcus and Mulkeen, 1984):

GEOGRAPHIC REGION	1961	1981
SOUTH	30.7%	33.6%
WEST	15.6%	19.3%
NORTH CENTRAL	28.8%	26.7%
NORTHEAST	24.9%	21.5%

The white population increased only 6 percent between 1970 and 1980 and decreased as a percentage of the whole in the same period. Blacks comprise twelve percent of the total U.S. population at present as compared to less than 10 percent in 1961. Two-thirds of all Hispanics in America inhabit Texas, New York, and California. The 25 largest urban school districts had a 51 percent minority enrollment in 1968, a 71 percent enrollment in 1978, and minority enrollment was predicted to reach 80 percent by this year. Twenty-five percent of the total public school enrollment in 1985 consisted of minority students, broken into 15 percent black, 7 percent Hispanic, 1 percent native American, and 1 percent Asian (Rakow and Walker, 1985).

The 44 big-city school districts (The Council of the Great City Schools) enroll nearly five million students. Seventy-three percent of these students are members of minority cultural groups. Thirty-three percent of all black students in America are found in these 44 districts (Council of the Great City Schools, 1986). Black students comprise 45.8 percent of the total student body. Eighty percent of all black students are located in just 202 of the nation's 16,000 school districts (Task Force on Black Academic and Cultural Excellence, 1984). The 1980 Census reveals that blacks comprise 12 percent of the total U.S. population, but represent 28 percent of the poverty population. On a brighter note, the Census figures also show that for blacks 25 years or older, high school graduates comprise 31 percent of this group in 1970 and 51 percent in 1980. The percentage of black college graduates for the same age group increased from 4 percent in 1970 to 8 percent in 1980 (Bureau of the Census, 1987). Black Americans have made significant gains in educational attainment over the last decade, yet it is clear that much more progress needs to be made.

Besides having to contend with poverty, many black children face other risks directly impinging upon their schooling. Brady

(1984) has listed a number of risk probabilities for black versus white children including but not limited to the following items:

1. Three times more likely to have a mother who dies in childbirth.
2. Twice as likely, if male, to die of congenital heart disease.
3. Three times more likely, if female, to die of heart disease.
4. Five times as likely to contract tuberculosis.
5. Twice as likely to lack regular health care.
6. Twice as likely to live with neither parent.
7. Three times as likely to be born to a teenage mother.
8. Seven times more likely to have parents who separate.
9. Three times as likely to see his/her father die while still a child.

Risk is a factor most urban minority youth are only too familiar with in their lives. Schools need to focus their planning on strategies of instruction that are likely to empower these minority students rather than to continue to collaborate with their environmental milieu in disabling them (Cummins, 1986).

SCIENCE ACHIEVEMENT SCORES AND BLACK STUDENTS

That some minority groups score at a significantly lower level on standardized tests is recognized by researchers from all different spectrums of political, social, and educational arenas. The large urban schools are two or more years behind the national norm in achievement tests (Cole, 1985). The seriousness of these differences can be seen from recent assessments in science achievement. A look at black students' performance in the 1980 National Assessment of Science and Mathematics showed that black students as a group experienced problems in math at all four tested taxonomic levels. As age increased within the sample, an increasing proportion of the troublesome exercises showed 20-29 percent or more total incorrect responses by black students. There were few exercises in science in which blacks' performances were above the national average. Black students, ages 9, 13, and 17, experienced problems with comprehension and application items and problems in biology and physical science content areas. Nine year olds experienced difficulties with analysis, synthesis, and evaluation items. Process methods were a problem for 13 and 17 year olds. Seventeen year olds also encountered difficulties with items focused on persistent societal problems (Holmes, 1980; 1982).

Data from the Minnesota Science Assessment and Research Project are not very comforting (Rakow, 1985). A large national study, researchers found that at age 9, whites scored approximately 12 percent higher than blacks or Hispanics. Sixty-two percent of whites reported experiences with science apparatus or science activities in their classes. Fewer blacks and Hispanics reported such experiences (57.6 percent and 56.4 percent respectively). By age 13, whites were approximately 10 percentage points above nonwhites and Hispanics averaged 1.5 percentage points higher than blacks. By age 17, whites were 11 percentage points higher than Hispanics and 15 percentage points above blacks. While there was no significant difference in the number of science courses whites and minorities take in high school, there was a significant difference in the number of college preparatory courses taken, with whites averaging about a third of a semester more than minority students. A situation reported in one American high school in the Southwest is all too common. The school population was over 50 percent Hispanic and black, yet not one Hispanic or black student was enrolled in physics. The physics teacher insisted that "everyone has an equal opportunity" (Atwater, 1986: 55).

Jones (1984) analyzed data from the National Assessments of Educational Progress, the Third National Mathematics Assessment of 1982, and average ethnic scores on the SAT to assess the relative change of black vs. white achievement for the last fifteen years. Every category surveyed revealed that blacks had gained on whites during the period. Some gains were at the expense of white decline (usually due to larger numbers of whites tested); most were due to actual gains in black achievement. Recent research by ETS found that blacks average SAT math scores for those planning to major in science, engineering, or math rose over the last decade from a mean of 400 to 417 for black males and from 367 to 388 for black females (Benderson, 1988). Despite these gains, mean differences in achievement between blacks and whites are still large. Like Rakow (1985), Jones also found differences between the numbers of college preparatory courses that blacks and whites were taking in high schools.

Reasons for sharp differentials between black and white achievement are elusive but there are some suggestions that merit attention. Payne (1984) found that black students register higher test anxiety than their white counterparts, and that this results in significantly more answer changing behavior. This changing of answers decreased the mean number of correct answers for those making such changes.

Nobles (1987) has suggested that the ultimate answer to black vs. white achievement differences has to do with the differing cultural deep structures that Afro-Americans and Euro-Americans possess (cf. Hilliard, 1976). Since the psychometric community is Euro-American in outlook, tests to measure intelligence, personality, motivation, and achievement are predicated on a Western consciousness that is at variance with African-American consciousness. Administration and interpretation of such instruments then becomes a self-fulfilling, socio-cultural justification for continued white supremacy. If such charges can be substantiated by research, it is clear that much of the observed gap may be cultural rather than academic. There is suggestive evidence in the area of motivation that this charge may be accurate (see below) but whether such differences can adequately account for the differences in criterion referenced achievement texts, remains to be proven. There is evidence that urban schools which systematically attack the problem of low achievement scores raise those scores substantially in subsequent administrations (U.S. Department of Education, 1987).

MINORITIES IN SCIENCE AND ENGINEERING

Minorities have attained the highest levels of scientific and technological education and achievement. Yet they have been underrepresented in American scientific and technological enterprises since before the days of Benjamin Bannaker. Taking a long view, we could argue that minorities are better represented today in science and technology fields than at any time in our history (Crowley et. al., 1982; 1984; Crowley and Lane, 1986). Such a bald statement, however, should not mask the fact that minorities in science and technology fields are still not proportional to their numbers in the population at large. Blacks, one of every eight Americans, earned only one of every hundred technical doctorates in 1987 (Vetter, 1988).

Fewer than 1 percent of all practicing scientists are Hispanics. In engineering, Hispanics represent only 3.2 percent of all full-time undergraduate students, 1.2 percent of all master's students, and only .7 percent of doctoral students (ERIC, 1981). Hispanics comprise 7 percent of the total U.S. population (U.S. Dept. of Commerce, 1986). Blacks are only 1.3 percent of U.S. doctoral scientists while Asians, by contrast, are 7.7 percent of doctoral scientists yet only 1.5 percent of the U.S. population (Hodgkinson, 1985). In 1980, blacks earned

9.1 percent of all associate degrees, 6.5 percent of all bachelor's degrees, 3.9 percent of all doctorates, and 4.1 percent of all first professional degrees (Task Force on Black Academic and Cultural Excellence, 1984). Overall percentages of Ph.D.'s awarded to blacks declined slightly from 3.8 percent to 3.6 percent from 1975 to 1986 (Brown, 1988). Within the nation's 2.7 million practicing scientists, blacks comprise only 1.5 percent of the total (Campbell, 1986). If we look at a specific discipline example, only 700 blacks, 840 Hispanics, and less than 100 native Americans were part of the 45,364 practicing American geologists in 1980 (Suiter, 1988).

The lack of minority scientists and engineers becomes critical at collegiate teaching levels as well. When only 820 blacks, 567 Hispanics, and 527 Asian-Americans earned Ph.D.'s in 1986 compared to 20,538 whites, the lack of qualified minority applicants is hardly surprising (Brown, 1988). Brown (1988:25) pessimistically concludes that ". . . Black Ph.D's have the most fragile status of all minorities and their participation in academics is, at best, marginal . . . . the Black doctoral pool has declined to its lowest level since 1975 and shows no sign of recovery." Predominantly white institutions who attempt to fill vacant teaching slots with minority professors cannot find applicants interested in filling the positions since they can make far more money in industry with a Ph.D. (Science, 1988; cf. table 4.2 in Brown, 1988; discussions in Pruitt, 1987). Many of the barriers to a successful undergraduate/graduate education transition are unidentified due to the lack of longitudinal analyses (Brown, 1987). The lack of university minority faculty exacerbates the minority representation problem since fewer role models then exist for undergraduate minority students to emulate. A fuller partnership between higher education institutions and private industry via internship programs seems imperative if the issue of role models is to be adequately addressed.

A study of minority women in the sciences based on the 1980-81 data from the National Research Council, the National Academy of Sciences, and the Scientific Manpower Commission, found there were only 4,809 minority women who held doctorates in science or engineering. While minority women earned a larger percentage of doctorates in science and engineering fields than in any other fields of the existing U.S. doctoral population in 1981, an ominous 94 percent of all minority undergraduate women and 93.5 percent of minority graduate women then in school, were majoring in fields other than science/engineering. Furthermore, the employment rate of science and engineering Ph.D.'s showed there were lower full time rates and higher rates of unemployment for all minority groups when compared to white scientists. While the authors point out that definitive conclusions as to causation are not possible from the data, these figures are nonetheless sobering (Hall and Malcolm, 1982). The percentage of black female engineers and scientists rose from 4 to 6.7 percent of all women in these occupations from 1972-1980. Black females account for 6.2 percent of the nation's population, yet in 1981, of the 1.5 million engineers in America, only 5,000 were black females (1 in every 300 engineers) (Project on Equal Education Rights, 1983).

Gains made in recent years have been due in large part to Federal funding that has fueled efforts at attracting and retaining minorities in higher education in the sciences and engineering. Whether the outlook for minorities will continue to improve will depend in part upon funding (Walsh, 1987). Yet money alone will not solve these problems. Deeply embedded social and cultural factors cannot easily be addressed by 'throwing' money at the problem (Subcommittee on Science, Research, and Technology, 1982; Chipman and Thomas, 1987). Major impediments for increased minority women participation, for example, include not only the gender stereotyped differential treatment women receive but treatment due to being a minority member in America (Grew, 1986; Hall and Malcolm, 1981). This 'double dilemma' cannot be eradicated simply by legislative fiat or financial inducements (Kahle, 1982a; Benjamin, 1982).

Malcolm et. al. (1976) surveyed 335 programs targeted to increase and retain minority participation in science and technology fields. Results of this survey are worth noting as further programs are contemplated. Thirty percent of the 335 programs were directly health related; 30 percent were targeted toward increasing the number of minorities in engineering and technical fields; 15 percent involved science education, science career counseling, environmental education, or general education efforts (including museum work); 3 percent were natural resource area projects (e.g. forestry, fisheries); and the remaining 20 percent were directed toward specific disciplines or combinations of the above emphases. One-quarter of the projects took participants from all minority groups and 35 percent were exclusively targeted to blacks (only 12 percent of projects surveyed excluded blacks). Programs concentrating exclusively on Puerto Ricans were notably absent. These programs span a fifteen year period, thus the total number of projects at any one time were very small as were "the estimated number of affected individuals" (Malcolm, et. al., 1976: 16). Nearly half of the projects were aimed at the college level. Eighteen percent were at secondary and only 7 percent at elementary levels. As the authors note: "These data become immediately significant if one notes that most minority scientists and educators identify the pre-college level as the one where there exists the greatest need for additional sustained effort to increase the pool from which minority students come" (Malcolm, et. al., 1976: 16). Many of the more recent programs have attempted to strike a better

balance between the educational levels targeted (see below). Equally significant for this study, nearly all of these programs were or are directed to the academically talented or those who with intervention show some academic potential. Roughly 80 percent of minority students in our urban schools are not within the purview of these intervention programs. Unless greater attention is paid to this underserved .pa
group of students in our urban schools, we can expect a growing underclass with experiences similar to those of Johnny Washington, related so poignantly by Grant Pick (1988).

SOME PROPOSED SOLUTIONS

The racist solution

Perhaps the oldest suggested solution to problems facing minority students in America has been the racist attitude that one should do nothing since nothing can be done. The psychometric community has promoted this attitude as recently as the fifties in officially sanctioned publications and there are still a few vocal advocates of this view (Nobles, 1987). Many who continue to hold to this view, have elected to keep their full opinions to themselves in these days of more enlightened civil rights legislation. Wooldridge and Richman (1985) report a study of 216 southern, white, female public school teachers who had to choose appropriate punishment for three standardized presentations of misbehavior on the part of students. Gender, race, IQ level, and age were varied systematically to create 24 subgroupings for teacher decision-making situations. Severer forms of punishment were recommended for males vs. females and white vs. black males. A hypothetical 16 year old white male with high IQ, for example, was given significantly severer punishment than his black counterpart. This was because he was perceived by these teachers as having greater potential than his black "classmate". Experiments such as these suggest that insidious racism is still alive and well in America. A Canadian study shows such problems are not unique to the American experience (Clifton, et. al., 1986).

The desegregation solution

Some have looked to desegregation as the answer to problems of low black achievement. Yet research indicates desegregation by itself is not the answer. Linda Grant (1984) conducted systematic ethnographic research in six desegregated first grade classrooms and found that no black females were ever singled out by the six teachers as having outstanding abilities in anything. From ten to eighteen percent of all other students were singled out for abilities in various areas. Black females rated as below average by these teachers were never designated as being simply "immature" yet 11 percent of the below average white boys were so designated. Teachers, when asked to describe students' academic skills, focused little on black girls academic performance but gave extensive descriptions of their social skills. They suggested that for these students such skills were more important than academic ones (cf. Scott-Jones and Clark, 1986). Patchen, Hofmann, and Brown (1980) report that being in predominantly white classes benefits only black students who were not academically oriented or came from families with low educational backgrounds and who self-selected black or white peers with similar orientations and backgrounds.

Dawkins (1983) took a look at over 3,000 black students from the National Longitudinal Study of the High School Class of 1972 to see whether attendance at desegregated schools substantially and uniformly changed blacks' occupational expectations (as compared to their parents' generation). He found that only southern black males were affected by the experience enough to plan to enter a non-traditional occupation. Black females and northern black males continued to desire occupations like their parents.

Hall, et. al. (1986) attempted to identify factors associated with racial differences in science achievement. They paired black and white sub-groups in achievement, attitude toward science, and attribution measures. Teachers of these students believed that black females exerted the most effort and black males the least. They consistently ranked white students higher in ability than blacks with comparable achievement scores. It is clear from studies such as these, that mandating blacks and whites spend considerable amounts of educational time together does not guarantee either social/cultural acceptance or increased achievement.

The black universities solution

A third answer that has been suggested is to let historic black colleges and universities (HBCUs) handle the problem. The Minority Institutions Science Improvement Project (MISIP) under the U.S. Department of Education is often pointed to as an example of efforts needed in this area (National Science Foundation, 1981). This program and its Title III of the Higher Education Act complement pours about $700 million per year into HBCUs (U.S. Congress, Office of Technology Assessment, 1988). While these programs have significantly upgraded facilities and often faculty in these institutions, they fail to address problems impinging on the degree of success such programs might have in science and technology fields since only the relatively meager MISIP funds have been directed toward these areas (Resource Center for Science and Engineering, 1979; United States Congress, Office of Technology Assessment, 1988). A look at raw statistical data and comparison with selected non-minority institutions of comparable size and geographic location, shows that massive financial intervention would be needed for a truly significant impact (Berry and Thompson, 1982). John Hall (1984) at the Lake Arrowhead Conference, suggested that the establishment of "nationally competitive research efforts" at historic black colleges and universities might be one way to redress some of the imbalances in this area since increased private and public funding under research grants would result.

It must be remembered that black colleges enrolled only 27 percent of black college students in 1980 as compared to 50 percent in 1970. Black colleges and universities, however, account for 34 percent of all undergraduate degrees and grant more than 40 percent of all degrees for blacks in agriculture, computer sciences, biology, math, physical sciences, and social sciences (College Entrance Examination Board, 1985). Their retention rate is, therefore, much better than predominantly white institutions of higher education. Traditionally black institutions awarded decreasing proportions of masters degrees to blacks for the period 1976 to 1981 but increased numbers and proportions of doctorates and first-professional degrees (Brown, 1987).

Major intervention in black colleges and universities is needed in regards to teacher education. The percentage of blacks in the public school teaching force declined from 8.1 percent in 1971 to 7.8 percent in 1981 while white teachers comprised 88.3 percent of the force in 1971 and 91.6 percent in 1981 (Williams, 1984). This is at the very time when black students increased and white students decreased as a proportion of the whole student population. Clark (1985) reports that the survey of the American Association of Colleges for Teacher Education found that within historic black institutions there were 9,051 prospective black teachers in 1974 but only 4,027 in 1981. In most black colleges in the survey (47 out of a total of 105 historic black schools) enrollment in science teacher education varied from 0 to 5 with most registering no students.

The role of traditional black institutions "is still crucial to the attraction, retention, and degree attainment of black students in higher education . . ." (Brown, 1987:18) Yet, it can clearly be seen from these data that black institutions by themselves cannot reasonably be expected to solve the problems outlined above. Sustained intervention at earlier stages of the educational process are clearly necessary. Raising interest levels in pursuing science and technology fields among middle school and upper elementary minority students is vital if course selection and preparation in pre-college years is to be of assistance in feeding more minority students into the college level science and technology pipelines.

The magnet school solution

A suggestion that has gained currency in recent years has been the use of magnet schools in science and mathematics, the arts and humanities, and technology. Their high achieving students have garnered numerous awards in national contests of mathematics and scientific achievement and skill, artistic performance, etc. While there is no doubt that such a concept has marked educational utility, magnet schools cannot solve the problem of minority underachievement. The magnet school frequently ends up being 65 percent white in the inner city, with schools just a few blocks away only 1-2 percent white (Maeroff, 1985). The case of one urban high school in Los Angeles (studied by the Carnegie Foundation) nationally known for its outstanding science and math achievement is illustrative of this de facto "segregation" even in non-magnet schools. The visitors noted that nearly all students in calculus and physics classes at the school were white. Many white students signed up for these classes even though they did not possess adequate prerequisites, preferring a "D" or "F" than transferring to a class on their level where they would have been the minority (Perrone, 1985).

The effective schools movement

An educational approach that has recently come to the fore is the effective schools movement. The federal government has promoted this approach and found ready adherents in many circles (Alamprese, 1986; Brookover, 1985; U.S. Dept. of Education, 1985). Lezotte and Bancroft (1985) have summarized the major premises of effective schools research:

1. The primary function of schooling is teaching and learning.
2. The primary basis for assessing the increased effectiveness of the school is in terms of students' outcomes.
3. The way in which a local school district chooses to monitor student outcomes is indicative of the educational outcomes that the district cares most about.
4. An effective school is one which demonstrates both quality and equity in its program outcomes.
5. Quality and equity are achieved and maintained only when the school improvement effort has been designed to accrue benefits for 'all' students.

A relevant example of effective schools research that can be used by administrators and teachers to target behaviors for change on the part of urban teachers is that of Winfield (1986). She conducted a case study of teachers in five inner city schools. She categorized how each teacher perceived academically at risk students in their classes as follows.

BEHAVIORS OF TEACHERS TOWARDS AT RISK STUDENTS

	Assume Responsibility	**Shift Responsibility**
Improvement	Tutors	General contractors
Maintenance	Custodians	Referral agents

Teachers, she suggests, can be grouped into four types. "Tutors" reflect the optimal level of effectiveness with at risk students. They are willing to do any and everything necessary to help academically at risk students succeed. These are the teachers who not only offer but actively promote out of class help for these students. "General contractors" believe that special help should be contracted out to specialists within the school, i.e. those having problems in reading in science class should be referred to the reading specialist; those having math difficulties in science should be sent to the math teacher for assistance. "Custodians" maintain that a lack of resources is the problem and that special programs and aids are needed to cope with their students. They simply present their material and leave it up to the students alone to pass or fail. "Referral agents" maintain that it is not their responsibility to help at risk students but is the fault of parents, home backgrounds, special program failures, or other agents or agencies outside of their classroom. There is no question that action research such as Winfield's study, can lead to identification and amelioration of some problems in urban schools with large minority populations. Inner city school administrators can screen out "custodians" and "referral agents" with concentrated effort to better serve their pupils.

Where the effective schools movement has sometimes gone too far has been insistence, by some school districts, on using standardized tests as the sole criteria for success of the strategies, materials, teacher, etc. As Lezotte and Bancroft (1985) have pointed out, outcomes need not necessarily be defined as results from standardized achievement tests. If this becomes the sole criterion then we have returned with a vengeance to the measured curriculum that had its heyday at two earlier periods in the twentieth century. In a push toward this managerial production model of education, the gap widens between those already well off socially and educationally and the disadvantaged.

A proper approach would be to utilize many of the procedures and recommendations of the effective schools movement but to decide at the local level those outcomes that are desired and achievable (Yin and White, 1986; U.S. Dept. of Education, 1987). Inner city schools for example, might consider such criteria as increased interest in science, choosing to attend college, engagement in community activities, increased school attendance, fewer disruptive behaviors, increased student/teacher interactions, etc.

The multicultural education solution

A final suggestion that appears to have merit in addressing the problems of minority learners is the need for multicultural education. Sometimes school districts have met this need by issuing fine looking handbooks but little in the way of substantive change (e.g. Anderson and Barta, 1981). What is needed is a more thorough, systematic attempt to inculcate in teachers and students an awareness of cultural differences. Attention is paid to this topic when dealing with obvious national differences as the focus of proceedings from international conferences on science education demonstrate (Gallagher and Dawson, 1986). Teaching culturally relevant science in the U.S. is only taken seriously by special interest groups, usually themselves minorities, like the Michigan Annual Hispanic Education Conference (Marinez and Ortiz de Montellano, 1983). Cultural differences in black and white communication styles and their effects on learning, for example, are rarely considered (Erickson, 1986). This can become particularly important when such differences in speaking are viewed as acceptable by blacks but unduly aggressive by whites (Bell and Jackson, 1984).

The problem of bilinguals in America has received a lot of attention because cultural differences are so obvious. School district handbooks to assist teachers in coping with the special problems of these learners are common in districts which have large numbers of bilinguals (e.g. Azios, et. al., 1975). Bilingualism lends itself readily to science education research studies and papers on the topic are featured at National Association for Research in Science Teaching meetings (e.g. Quinn and Kesslet, 1980). Some have even raised the question whether dialect of minority students might play a significant role in explaining educational failure since the way language is used in school is frequently very different from its use in the community (Toohey, 1986).

Substantially less attention has been paid to the cultural and social contexts of minorities who are not obviously different linguistically. Urban, inner-city culture is rarely talked about in educational journals except those devoted exclusively to minority education or urban contexts (e.g. **Urban Review, Education in Urban Society, Journal of Negro Education**). Teacher science education texts generally fail to mention the special problems of minority students (a notable but minor exception is Trowbridge, Bybee, and Sund, 1981). Courses in teaching methods fail to deal with special problems raised by teaching in the urban environment. We prepare teachers inadequately to cope with the "real" world of the city. That such an environment is different can be appreciated by the uninitiated by reading comparative descriptions of three urban schools chosen by the Carnegie Foundation for the Advancement of Teaching versus schools in suburban or rural contexts (Perrone, 1985). David Ley (1974) in a little known study, termed the inner city "a frontier outpost".

Just inserting materials in curriculum does not guarantee that multicultural perspectives will be presented. Fuller and James (1980) surveyed 353 teachers who were using a curriculum materials set which incorporated the contributions of black scientists. Thirteen percent of these teachers had previous educational exposure to minority achievements of any kind. Only 3.7 percent had studied the contributions of black scientists in their own education. When asked how often they taught contributions of black scientists to their students, 2.5 percent said "always", 5.6 percent said "often", 11.8 percent said "occasionally", 20.6 percent said "seldom", and 58.2 percent said "never". These findings are especially interesting since the materials for such teaching were already in the teachers' possession and the sample area had high concentrations of black students.

What kinds of competencies should characterize successful teaching in a multicultural setting? Campbell and Farrell (1985) asked a sample of Dade County, Florida public school teachers to rank 54 items in their perceived order of importance for successful teaching in a multicultural setting. The top ten items in rank order were:

1. concern for students;
2. is accepting (able to work with students regardless of race or ethnic background);
3. identifies and/or develops appropriate materials for students;
4. shows a genuine interest in students;
5. is able to give clear directions;

6. has patience with students;
7. likes teaching;
8. is able to interact in a positive manner with students whose ethnic background is different from their own;
9. shows consideration for students;
10. shows enthusiasm in teaching.

The authors note that eight out of these ten items are affective rather than cognitive in nature, suggesting the importance of attitudes in multicultural settings. The ten lowest items from the survey are also of some interest since they go against some cherished assumptions often made in this arena:

1. runs a democratic classroom;
2. bases learning experiences on ethnic backgrounds of students;
3. applies an interpersonal problem solving approach;
4. uses student ideas in planning activities;
5. demonstrates knowledge of culturally related terms;
6. has an understanding of the history of various ethnic groups;
7. is able to write performance objectives;
8. uses a variety of questions based on Bloom's taxonomy;
9. is able to administer sight, hearing, or speech examinations;
10. is able to write behavioral objectives based on Bloom's taxonomy.

Surveys such as this might guide selection of appropriate multicultural education activities for prospective and practicing teachers. It also suggests necessary "deeducation" activities if widely held teacher perceptions of the importance of a given competency are misplaced.

The exposure of teachers to multicultural education does have a positive effect according to a study by Grant and Grant (1984). Thirty experienced teachers and principals exposed to a two week,three phase, teacher in-service program in Multicultural Education, did show significant differences in their post workshop awareness of and attitudes toward multicultural differences. Campbell, et. al. (1980) reported that information on black scientists can alter the belief systems of closed minded individuals. Preservice teachers were assigned to two experimental groups based on their median Rokeach Dogmatism scores, which served as a pretest. One group was randomly assigned instruction in science process skills, plus information on black scientists. The other group received instruction in science process skills plus instruction on various books for elementary children. Upon completion of the instruction, the Dogmatism test was again administered. Analysis of variance showed a positive difference favoring the group receiving the information on black scientists. Continued existence of prejudice on the part of many science teachers towards their minority students can best be addressed by teacher education programs that actively acknowledge and attempt to deal with this pernicious problem.

THE CULTURAL CONTEXTS OF EDUCATION

That cultural differences are important determinants of what is taught and learned in educational settings should be obvious to all. The Center for Studies in Science Education at the University of Leeds, England listed over 800 references in the literature to economic, linguistic, political, religious, philosophical, social, and psychological contexts of science education (Wilson, 1981). Researchers like Michael Apple, H. A. Giroux, Paolo Friere, S. Lubeck, Elizabeth Vallance, and Ivan Illich have reminded us of the power and importance of both the hidden and the stated curriculum of American schooling. Failure to understand and appreciate black, urban culture and adjust instructional strategies and educational policies in the light of such realities only invites further failure on the part of the new majority in urban schools.

Castelike minorities

John Ogbu (1974; 1978; 1982; 1985; 1986), an educational anthropologist at the University of California, Berkeley, has tried to answer why some minority groups persistently fail in American schools. The answer, he suggests, is not due to teaching or uncooperative (bad) students, but related to ways in which majority groups have treated specific minorities and how those minorities have responded to such treatment. He distinguishes three types of minorities: a.) autonomous: those who "possess distinct group identity or sense of peoplehood, based on cultural, language, racial or religious differences with the dominant group" (Ogbu, 1985: 862), e.g. the Amish, Jews, and Mormons; b.) immigrants: "people who have recently moved more or less voluntarily to their host society" (1985: 863); and c.) castelike or subordinate minorities: who have ". . . been incorporated into the society where they are found more or less involuntarily and permanently through slavery, conquest, colonization" (1985: 863), e.g. Mexican Americans, native Americans, and American blacks. The autonomous groups generally achieve at very high levels in school and in society as a whole because they actualize a conscious choice to be different. They often consider themselves superior in some way to the surrounding majority. Immigrants generally do very well in schools and in society as a whole for several reasons. First, they usually compare their present standard of living with the standard of living of their home country. In the U.S. context, this means many of them are immediately better off upon arrival on American shores. Second, they often came to this country due to perceived opportunities for improving their standard of living, their overall wealth, or for increased political freedom. These motivating factors continue to exert influence on immigrants' adaptive strategies in their new host country and enable them to succeed. Lastly, they are not threatened by learning the culture, language, or life style of the host nation since they can successfully accomodate to the new while retaining the best of their own cultural heritage.

Castelike minorities on the other hand, have been forced to drop their language, culture and life style as befits a subjugated people. They are grouped into large categories and seen as homogeneous when for example, there is a vast difference between a Sioux and a Cherokee, an Igbo and a Fulani. Since they have been forced to live in the U.S., they resist their conqueror or masters in subtle and indirect ways such as deliberately maintaining "substandard" english (their way of creating and using their "own" language); deliberately failing in the educational system (since to succeed identifies them too closely with their oppressors and says "I give into your demands upon me"); and creating alternative economic systems with the resources at hand (e.g. the inner city crime economy?). More recently Fordham and Ogbu (1986) have suggested that black students who choose to succeed in school have to cope with the "burden of acting white", since to their peers they are no longer part of the group but have become 'renegades'. Foster and Warner's (1985) interviews of minority college students, reinforce facets of Ogbu's research. A critique of Ogbu's thesis, centered on historical problems, is that of Stewart (this volume).

An alternative explanation to Ogbu's thesis comes from Lieberson's 1980 study which argues that the economic well-being of black families as compared to waves of white immigrants from 1880 onwards has been the crucial factor creating race differences in grade attainment since "there is no indication that blacks were initially less interested in education or less willing to sacrifice to achieve it " (Lieberson, 1980: 252). His views have been supported with some qualification by Perlmann (1987).

Cervantes (1984) suggests that due to changing demographics in America, the period from 1985-1990 will be critical if the current ethnocentric pedagogy is to be overcome and minority student achievement enhanced. He recommends the following courses of action at the administrative and school level:

1. Recognition that America is neither monolingual nor monocultural;
2. Increased minority participation in policy making;
3. Concentration on failures in school rather than successes;
4. Place the role of schools in broader social and economic contexts;
5. Implement alternative approaches to instruction;
6. Change the emphasis in testing from testing children to assessing the effects of different programs on children.

Drop-outs

A large problem that needs to be addressed by new curricula and by enlightened teachers is the high proportion of dropouts among inner city minorities. Silvia Williams (1987) studied dropouts from the Pasadena Texas Independent School District. She found that their low socioeconomic environment was similar in relation to demographic, personal, and family characteristics as that of high school graduates in the same system. The distinguishing feature of the two groups was the pervasive feelings of isolation, disconnectedness, and rejection that epitomized the dropout. The reasons for these feelings was not explored. Mary Ann Raywid has been looking at this problem for some time. Recently she summarized (Raywid, 1987) a series of studies that showed that schools can be injurious to the mental health of minority youth who drop out. The behavior of some dropouts improves and aggression declines after leaving and self-esteem and sense of control rise. Returning to school often has a negative effect. These findings tie in closely with Ogbu's work (discussed above) and may be explained by his model. Raywid suggests there be greater collaboration with social and community agencies to promote school success and increased collaboration with the world of work (cf. Stewart; Flint; Flint and Thomas, this volume). Raywid reminds us: "School/business ties were earlier thought to be nice; they have now become essential. Schools urgently need the help of the business community in dealing with at-risk youngsters" (1987: 227).

The home environment

Besides the "burden of acting white", there is evidence that black children whose parents are experiencing upward social mobility, suffer from lack of confidence, lower self-concepts, and are more likely to engage in debilitating behaviors (Willig, Harnisch, Hill and Maehr, 1983). That home environment definitely impacts on student learning seems obvious but is difficult to pin down in an explicit manner. Shade and Edwards (1987), based on their own ethnographic research and that of others, suggest there are differences between Afro-American and Euro-American home environments in regards to visual forms, play, family interaction, and environmental orientation. They write: "From all indications, Afro-American families have found it important to stress social rather than instrumental cognition. This orientation provides the student with guidelines for interpreting and constructing their social environment" (1987: 99). Slaughter and Epps (1987a; 1987b) have found that a positive learning environment does exist in some lower socio-economic class black homes. But they point out: "For many Black families, the daily struggle for survival takes precedence over all other concerns. . . . Blacks will again perceive a strong, viable connection between educational attainment and work when they can see employment opportunities for themselves and their children as a reality in the society" (1987a: 20). Descriptive statistics from samples of the National Survey of Black Americans, The Three Generational Family Study, and the National Survey of Young Black Adults, showed that the sample of young blacks had high educational attainment, yet were sizably unemployed (Wilson and Allen, 1987). Until society at large can meet this challenge, it is highly doubtful education within the American system will hold much promise for young blacks (see Flint; Flint and Thomas, this volume).

A final aspect of the home environment that should be mentioned is the role of television. A review of empirical studies of black children and television found that as a group, black children and adolescents' viewing time exceeds that of any other racial group. Black children believe in the reality of television more than other groups, especially identifying with black characters. Very little is known about how these and other factors associated with this technological device are impacting upon the intellectual and social development of black children since most studies of T.V.'s influence have been conducted using only white children (Stroman, 1984).

Motivation

When it comes to motivation, there is evidence that standard motivational theories developed for whites may not adequately explain motivation in blacks. A recent model that appears to hold considerable explanatory utility in regards to motivation in blacks is the attribution theory of Weiner. This theory has three components that make it particularly relevant: 1.) determination of self-concept and its relationship to achievement; 2.) interrelated constructs that deal with cognitive and personality factors; and 3.) sensitivity to the dynamics and results of failure (Graham, 1988). A more complicated model than many previously proposed, the theory considers causal antecedents, perceived causes, causal dimensions, psychological consequences, and behavioral consequences. When black students fail, they are more likely to attribute failure to task difficulty and/or lack of ability than either white or Hispanic children according to a study done with fourth through eighth graders in suburban Chicago (Willig, Harnisch, Hill, and Maehr, 1983). Black females were found to be far more likely to use debilitating self-attributions than either black males or white/Hispanic children.

An on-going study of 4,000 science students in grades 6-10 in central North Carolina, found no racial differences in attitudes toward science and achievement motivation profiles at tenth grade, but significant differences favoring whites at grades six through eight (Simpson and Oliver, 1985). For ninth graders (an advanced science class), the mean for high ability black students' attitude toward science was considerably better than their white counterparts. These results imply that intervention strategies designed to increase motivation toward science learning are critical in the middle school years. If black students are not motivated to learn science in middle school, later intervention programs at high school levels can only partly ameliorate the problems since three years of science learning have been effectively lost (Epps and Jackson, 1985).

Role models

The importance of role models for black students has frequently been mentioned as a necessary motivational ingredient if an interest in science and technology based careers is to be encouraged (e.g. Marchand, 1980). There is evidence that even first and second grade black students remember far more of the details of a story when the characters are black (Smith and Lewis, 1985). A study of seven contemporary elementary science textbook series by Powell and Garcia (1985) gives an idea of the kinds of representations ("role models") students are encountering in their science books. Female children appear more frequently in science and nonscience activities than their male counterparts but less often in science-related career roles.

Minorities appear proportional to their size in the population at large, but minority adults in science related career roles or activities appear less frequently than their proportion in the population.

Attracting and retraining minorities for teaching careers is essential if schools are going to seriously reckon with the need for role models in science classes (Rodriguez and Rodriguez, 1986; Baratz-Snowden, 1988). Relationships and communication between practicing minority scientists, engineers, and educators at all levels of the educational system must be encouraged. Anderson (1979) surveyed black scientists to discover how elementary school science education can encourage greater minority interest and career participation in science and math. The scientists rated teacher influence as the most critical factor leading them to a career in science. Elementary teachers exposed to the interviews and survey forms of these scientists selected teacher influence, parental involvement, community influence, and role models as being most useful in altering the attitudes of black children toward science. Walter Massey, President of the AAAS, relates how white scientists, properly attuned to cultural differences, can successfully mentor black students (Powledge, 1988).

SCIENCE EDUCATION FOR MINORITY LEARNERS

Promoting student interest in science

Some important impediments to effective learning are outside the influence of the classroom teacher. Generating minority student interest in science, however, is something over which a teacher has a degree of control and influence. Thomas (1986) undertook a study of 2,046 junior/senior college students to look at factors influencing their choice of science study at the collegiate level. Key factors that emerged from her study were: 1.) students had an interest during childhood in science hobbies; 2.) early aspirations of becoming a scientist; 3.) encouragement by significant others in their lives to pursue math/science majors; 4.) good high school grades in math and science; and 5.) participation in high school math clubs. This study reinforced earlier work that showed that students' career interests in science and mathematics develop at an early age (generally in late elementary or early middle school).

The need for intervention strategies at these levels is critical to seeing additional minority students desire to pursue math and science based careers. As Walter Massey, President of AAAS recently stated in an interview ". . . the long-run solution, of course, is getting students interested in education and learning at a very early age. I would urge government and foundations to put more resources into preschool programs"

(Powledge, 1988:9). Waiting until high school, and then trying to stimulate their interest is too late to be effective, although there is little doubt it helps foster interests already present. After school science clubs for high school age minority youth, like those run by the Oregon Museum of Science and Technology in Portland, should be broadened in their scope to include younger sets of minority children. A survey of 163 fourth through eighth grade programs promoting math, science, and computer science for minority and/or female students has recently been completed by the Educational Testing Service (Clewell, Thorpe, and Anderson, 1988). A subsequent project will seek to identify intervention methods that work best.

The role of attitudes toward science and math was one of four factors noted by Ponzio (1981) as most pervasive and important in restricting minority participation in science and science related professions. The others were lack of role models, the amount and nature of counseling, and necessary preparation in math and science at the precollege level. He maintains that industry and institutions of higher education need to take a more active and collaborative role in efforts to increase minority interest and abilities in science and math at precollege levels. There is a great need for longitudinal studies of minority women and men from upper elementary levels through the baccalaureate level along the lines of the pilot study by Turner, et. al., (1983).

A study of eighth graders in an inner city junior high school by Jacobowitz (1980; 1983) showed that of all independent variables studied (sex, math achievement, science achievement, and science self-concept), gender was the strongest predictor of science career preferences. This suggests that science career preferences arise more from gender-related interests than from realistic assessment of mathematics or science achievement. Black students' career plans are usually less related to their grades and standardized test scores than those of white students (Berryman, 1983). This is particularly true of black females (Kahle, 1982b). A study of exceptional high school biology teachers who had high numbers of female students going on in science education, was undertaken by Matyas (1984) to determine what factors might be important in encouraging young women to remain in the science track in high school. Her results indicated that the best predictor of science career interest for females was their positive feelings towards science classes. Compared to males in the sample, females expressed less confidence in their science and problem solving abilities and reported less frequent participation in curricular and extracurricular science activities.

Eight affective scales and one cognitive achievement scale were analyzed for a large sample of 17 year olds by Napier and Riley (1985) to find out what factors foster achievement in science. They identified the following factors as being important:

1. The teacher encourages students to do extracurricular work including discussing science with others;
2. Course work is not too difficult and students feel comfortable and not "stupid";
3. The teacher avoids too much latitude in student choice of topics or projects for class;
4. Topics are sequenced in some logical fashion and mode of learning, rate of work, and test taking are well planned;
5. Students are allowed to state opinions and encouraged to think for themselves;
6. Students are encouraged to be creative;
7. The teacher is apt to admit he/she does not know everything;
8. Teacher takes a personal interest in students

While most of these findings are not surprising to good teachers, they do need frequent repetition. Factors like the above set must become the rule rather than the exception, otherwise there will be a downturn in science and mathematics interest at the college level. This is exemplified by a fairly comprehensive study of science education at an urban community college (Friedlander, 1981). Selected findings from this study showed that:

1. Just over 40 percent of students completed one or more science courses;
2. Withdrawals accounted for 32 percent of student grades in their first science course;
3. The majority of student respondents had not been encouraged to enroll in science classes in high school or college;
4. There were large discrepancies between students' career objectives and courses in which they were enrolled.

A study of science and non-science majors at a large, urban, historically black university in Baltimore found significant differences between the two groups in regards to course counseling, attitudes toward science, the presence of a role model, high school science background, science self-concept, and the image of science as field of study (Salters, et. al., 1987).

The science curriculum

Science teachers rely heavily on their textbooks according to a recent synthesis of three NSF reports on science education at precollege levels and the results of the National Assessment of Educational Progress in 1980-81 by Harms and Yager (1981). The following major findings are instructive of what really is going on in precollege science classrooms across the nation:

1. Science curriculum and students are woefully mismatched;
2. Ninety percent of science teachers only emphasize knowledge necessary to advance to the next level;
3. Ninety-nine percent of science teachers are only philosophically oriented to one specific scientific discipline;
4. Ninety percent of science teachers use the textbook ninety-five percent of the time they spend teaching;
5. There is scant evidence that science in our schools is being learned by direct experience.

Tobin (1987) has synthesized five studies of high school math and science classes in Perth, Australia and Georgia. His findings ". . . . indicated that the ability of teachers to manage student behavior effectively was a major driving force on the implemented curriculum. Other factors which influenced what happened in classrooms were tests and examinations, and textbooks. Most teachers endeavored to cover the curriculum in the planned time whether or not learning occurred and the cognitive demands of the work were low. . ." (1987: 298).

This heavy reliance on textbooks is particularly harmful when it is considered that large numbers of urban minority students are three or more grade levels behind in reading (Dupuis, this volume). Thelen (1984) has produced a helpful handbook on reading in science classes. Recently, Larry D. Yore (Yore and Shymansky, 1985; Yore, 1986) has focused on this critical area in science education and suggested some factors that must be kept in mind by curriculum producers and teachers as well as areas that desperately need research if progress is going to be made. Lehman, Carter, and Kahle (1985) report that teaching inner-city students to use heuristic devices like concept mapping and vee mapping may assist students in extracting and assimilating information from textbooks (Huber, this volume, explains these techniques). This is further supported by research that Afro-American cognitive style tends to be more spontaneous, flexible, open minded, and less structured in perceptions of people, events, and ideas than the Euro-American style (Shade, 1982, 1986). When one considers that science cognition also requires structure and precision of thought and observation, study aids that promote such actions should be actively promoted with black students.

Walker (1980) makes a strong plea for direct teacher intervention with minorities and female students by using teacher designed science curriculum and utilizing multiple structures and techniques that allow for different learning styles, cultural freedom, and verbal as well as written assessment. The challenge, of course, is to create enough time and supply the necessary resources for teachers to escape from the textbook driven curriculum.

Career and course selection counseling

There is some evidence that black inner city students accurately perceive the relationship between academic status and their future socioeconomic position in society (Simmons, 1979). They do not show such awareness in regards to science careers. Inner city black students generally select math and science courses that fulfill minimal requirements rather than the rigorous courses that are linked to pursuit of a math, science, or technology based career field (Jones, 1984; Rakow and Walker, 1985). Black students who report that they wish to pursue a career in science and technology, frequently do not sign up for the necessary courses to realize their goals.

A study of the career preferences of 261 eighth grade black students in New York City revealed not only that gender was a strong predictor of preferences but also that black adolescents are not aware of the relationship between good math skills, general school achievement, and science careers (Jacobowitz, 1983). Better career and course selection counseling at middle and high school levels is clearly needed. Research by Goggins and Lindbeck (1986) for example, indicates that grades in English may be a useful predictor of black students' success in high school science courses.

The necessity of black role models in science and technology based fields has already been stressed. Not surprisingly, there is evidence that black students at predominantly white institutions with few black teachers and/or counselors, prefer a counselor of the same race (Ponterotto, Alexander, and Hinkston, 1988; cf. Atkinson, Fulong, and Poston, 1986). This ideal situation is probably not achievable in the near future. Alternative strategies that provide quality counseling for black students must be devised.

A potentially useful model utilizing a group technique has recently been suggested by Kutsick and Jackson (1988). The program of 26 contact hours spaced over a 16 week period is designed to help students identify educational and/or precareer goals they would like to reach. The skills needed to overcome obstacles to their current and future success are then taught. A cooperative program of The John Hopkins University, the National Consortium for Graduate Degrees for Minorities in Engineering (NACME), the University of Michigan, and N.A.K. Production Associates will be producing a 13-episode program called "Journey" targeted to multi-racial, multi-ethic populations of teenagers, ages 13-18. Supplementary materials will guide teachers, guidance counselors, and interested non-educational associations in its use. Field testing of the first several programs has already commenced and appear to hold great promise (Habarth, 1988). To the extent that such models are proposed, tested, refined, and widely implemented in urban schools, a better match between abilities and career and educational choices of black students should materialize.

SUCCESSFUL SCIENCE PROGRAMS FOR MINORITY STUDENTS

Successful science programs in elementary and secondary science have certain common features including:

1. Immediate involvement in "doing" science in the lab in order to convey its utility;

2. Early recognition of deficiencies, careful grouping, and curriculum planning to create early success;

3. Clear, well-defined goals;

4. Sensitivity to student differences in selecting cues, processing information, and analyzing data;

5. Sensitivity to student differences in reactions to criticisms and praise (Ascher, 1985).

Shirley Malcolm and others (1984) provides an even longer list of sixteen characteristics of successful programs that includes funding and policy issues in addition to curriculum based concerns. They are worth citing:

1. Strong academic component in mathematics, science, and communications, focused on enrichment rather than remediation;
2. Academic subjects taught by teachers who are highly competent in the subject matter and believe that students can learn the materials;
3. Heavy emphasis on the applications of science and mathematics in careers in these fields;
4. Integrative approach to teaching that incorporates all subject areas, hands-on opportunities, and computers;
5. Multiyear involvement with students;
6. Strong director; committed and stable staff who share program goals;
7. Stable long-term funding base with multiple funding sources;
8. Recruitment of participants from all relevant target populations;
9. University, industry, school, etc. cooperative program;
10. Opportunities for in-school and out-of-school learning experiences;
11. Parental involvement and development of base of community support;
12. Specific attention to removing educational inequalities related to gender and race;
13. Involvement of professionals and staff who look like the target population;
14. Development of peer support systems (involvement of a critical mass of any particular kind of student);
15. Evaluation, long-term follow-up, and careful data collection;

16. "Mainstreaming" - integration of program elements supportive of women and minorities into the institutional program.

It is clear that funding and policy issues are critical to the success of any program. Cole and Griffin (1987: 93) remind us:

> To address the problems of educational achievement among minorities and women, a special program is mounted with extramural funds. When the program succeeds, that source of funds is no longer available because it was for program innovation, on the assumption that successful programs would be taken up by the sponsoring institutions. However, these institutions have no provision in their budgets or programs for uptake; they would have to dislodge already entrenched programs, which they are not willing or able to do. So the successful program dies away. Then the problem is rediscovered, a new program is put in place, and the process begins over again.

Since the sixties, there have been many programs to enhance minority achievement and promote minority student interest in science and technology. Programs from the period 1960-1975 have already been discussed above. Some general surveys of more recent programs since that time include those of Humphreys (1982), Malcolm et.al. (1984), Clewell (1987), and the Proceedings of the National Conference on Precollege Education of Minorities in Science and Engineering (Proceedings, 1989). There are currently more than 507 programs at precollege levels designed to increase science, math, and engineering interests (Student Science Service, 1987). Here we will focus only on some programs that seem to have special merit or are of recent vintage.

The Lawrence Hall of Science

One of the best known and widely used earlier projects was the Science Curriculum Improvement Study (SCIS) produced by the Lawrence Hall of Science, the University of California at Berkeley (Thier, 1970). Designed to meet the needs of disadvantaged children as well as other students, the program was widely used in urban and rural school districts with large minority populations in the late sixties and early seventies. Some particular strengths of the program were careful control of reading levels within the materials, a focus on everyday applications of science principles, multiple learning strategies and assessment procedures that took account of learning styles and cultural differences, and minority professionals in science, math, and engineering fields as textbook role models. The program is still used in some schools.

Recently the Lawrence Hall of Science has developed three programs targeted for differing needs (Kreinberg, 1982). EQUALS, a program originating in 1977, provides teachers with in-service training and materials to attract women and minority students to the field of mathematics. Over 16,000 teachers have participated in the 30-hour program and regional sites are now being developed for expanded in-service efforts (Association of Science-Technology Centers, 1987). Students of SPACES are helped to develop skills that will aid them in gaining access to careers in engineering and science. Both programs are activity oriented. FAMILY MATH focuses on upgrading the skills of minority parents to enable them to help their children improve performance. Preliminary studies show significant increases in knowledge of and interest in spatial visualization and problem solving skills in math. Additionally, the Lawrence Hall of Science has fostered the development of the MATH/SCIENCE NETWORK, designed to promote participation of women in math and science through the associative efforts of scientists, engineers, educators, and parents.

MESA

An innovative program, "Mathematics, Engineering, and Science Achievement (MESA)", is making headway in preparing talented high school minority students for math-based fields (Atwood and Doherty, 1984). Initially, a joint program of the State of California, the University of California, California State University, private business and industry, MESA was initiated in 1970 in three schools. Headquartered at the Lawrence Hall of Science, 16 centers served nearly 100 high schools with 2,500 students (primarily black and Hispanic) participating in 1982. Today 22 California colleges and university campuses participate with 17 hosting MESA Campus Centers and 17 hosting precollege programs (MESA, 1988). Current plans are to expand coverage from the present 100 high schools and 55 junior highs to encompass another 400 sites throughout the state.

Limited in scope and well defined, MESA does not attempt to reform schools at large or reach large numbers of minority students. Only academically talented minority students with an interest in math/science are selected. For these individuals the program provides enrichment and support that encourages academic success, including financial incentives for superior performance and extensive informal counseling. A recently named Rhodes Scholar in material sciences, a graduate of the program, Michelle DeCoteau, exemplifies the success of the program, pointing out that "When I began my studies, I was one of three Black women in engineering, so you can imagine how it felt to look around me and see virtually no one else in my own image. No matter how much

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self-esteem you have, there are times when you look around and have this feeling that you don't belong here . . . they (MESA programs) can make the difference between failure and success" (MESA Newsletter, 1988:3).

Two evaluative studies of the program have been completed. The first showed that MESA seniors had completed more science/ math courses and showed higher academic performance than similarly talented minority students who for one reason or another were not part of the program. An important caveat, however, was that verbal and math performances of these program participants was still below seniors nationwide who were planning math-based college majors. The second study looked at MESA students who had gone on to universities and were pursuing math-based majors. With few exceptions, students were found to be progressing satisfactorily (Atwood and Doherty, 1984). Portland (OR) began an active MESA program in 1985 (Erzurumlu, Hartzog, and Anderson in Proceedings, 1989). Maryland MESA recently commenced operation at 4 high schools and 5 middle schools in the state under sponsorship of the Applied Physics Laboratory of The John Hopkins University.

The Urban Project

An East Coast program similar in scope and nature to MESA is the Urban Project (UP) of the City Colleges of New York (Bengis, 1983). Promoting minority advancement in the sciences and technology for high school students, the focus once again is only on those who have demonstrated potential and interest in math and science based careers. UP students receive supplemental instruction in math, science, computers, and basic skills at participating City Colleges of New York campuses on weekends, after school, and at night. Data collected by the project at present suggests that UP is succeeding in retaining participants and in motivating them to pursue math and science studies at the college level. A summer institute (SMSI) has recently been added to the program to increase the involvement of these students in the basic sciences and mathematics (Ellis and Smith, 1987). Students are placed with a mentor for the summer and conduct a small research project under supervision during the internship. Howard University in Washington, D.C. and Hampton University in Virginia have recently instituted programs similar to SMSI.

FAMU

The Florida Agricultural and Mechanical University (FAMU) in Tallahassee, has a cluster of programs targeted to increase science, math, and engineering interest and achievement of minority students at precollege levels. One of the few universities to develop a broad based strategy, FAMU has programs in elementary, middle and high school students involving weekend academics, summer camps, summer internships in laboratories, and rigorous summer courses to prepare high school graduates for engineering programs (Padmore and Rogers in Proceedings, 1989). Another strong feature of the programs at FAMU is the partnership of parents, state government, the public school system, teachers and counselors, university administration, private industry, and the community.

The NTA

The National Technical Association (NTA), the oldest and largest black scientific/technological association in America, has recently initiated four programs to increase minority participation in mainstream technology (King in Proceedings, 1989). These programs are designed to supplement existing school career counseling efforts in science, engineering, and technology by tapping the members of NTA as resource speakers and personnel. A particularly innovative effort is the "Get SMART Program" which is conducted outside of school in community organizations and churches. A Student National Technology Association has existed since 1978 and has numerous chapters throughout the nation. Partnerships have also been recently formed between the NTA and the NAACP; the American Association of Blacks in Energy and the Black College Satellite Network at Howard University; NASA; and the Congressional Black Caucus and National Urban Coalition. The NTA believes these partnerships will result in greater minority participation in technology fields.

Project SEED

Project SEED of the American Chemical Society (not to be confused with the project SEED discussed below) began in 1968 with a personal contribution of one-half million dollars by the then president of the American Chemical Society, Milton Harris (Brown in Proceedings, 1989). Project SEED was initially an ACS "backwater" but has gradually been elevated to increasing prominence. The program provides academic or industrial laboratory internships for economically disadvantaged but capable high school students for a ten week summer period. Students receive a stipend of $1000, career counseling, laboratory experience, theory courses, and personal guidance from preceptors who are well established professional scientists. Since its inception, Project SEED has served over 2,000 students, placing them in over 250 scientific institutions and laboratories. Students in the program who wanted, but were financially unable, to go to college have received 100% funding from Project funds.

Other programs

SECME (Southeastern Consortium for Minorities in Engineering) is a project run by the Georgia Institute of Technology in Atlanta. At a cost per pupil of $30 per year, the program has encouraged math and science learning for more than 10,000 black middle/high school students. After participation in the program, more than 80% of SECME students plan to attend college as well as outperforming the national average SAT score for blacks by 140 points (Campbell, 1986; Drayton in Proceedings, 1989).

Project SEED (Special Elementary Education for the Disadvantaged - not to be confused with Project SEED of the American Chemical Society discussed above) is a program in Berkeley, CA that taps the University of California's location and sends mathematicians and scientists to teach for a day in elementary schools serving disadvantaged students. Preliminary evaluation found students achieving two months growth in arithmetic for each month spent in the program (Campbell, 1986).

"Expanding Your Horizons", a project of the Math/Science Network of Mills College, Oakland, CA consists of one day sessions that introduce girls to careers in math and science, provide hands-on experiences, access to role models, and information about links between math and careers. Students who have enrolled in the program do sign up for and generally exceed the number of math courses they said they would take after participating in the program (Campbell, 1986).

Science museums, like the Lawrence Hall of Science (discussed above), are key players in promoting science education for minority members of our society. A 1986 meeting of science museum representatives, researchers, and community groups interested in equity issues resulted in increased awareness and efforts on the part of museums to feature exhibits that promote awareness of minority contributions to science and technology. Collaborative efforts of museums with local community organizations and schools demonstrate the significant impact sustained efforts in this area can have in affecting career aspirations of minority students (Association of Science-Technology Centers, 1987).

The University of North Carolina Mathematics and Science Education Network (MSEA Network News, 1988) served more than 600 minority students in its first year of operation. The program not only focuses on science and mathematics but also training in communication skills.

Industry and professional organizations

Industrial giants like Hewlett-Packard, E. I. DuPont de Nemours, Eastman Kodak, IBM, RCA, and the Olin Charitable Trust have formed cooperative arrangements with schools to encourage math and science in high schools (Ponzio, 1981). Noteworthy sponsors of efforts targeted specifically to increase minority participation through special programs include Merck and Co., Allied Signal Inc., AT & T, BASF Corp., Westinghouse, Bell Communications, Ciba-Geigy Corp., Colgate Palmolive, Dow Chemical, GAF Corp., Johnson and Johnson, Shell Oil, Union Carbide, and Hoffman LaRoche. The National Action Council for Minorities in Engineering (NACME) has commitments of over four million dollars per year from 40 Fortune 500 companies plus 135 other corporations that enables NACME to currently support over 400 minority undergraduate students in engineering studies at 150 colleges and universities. Bell Laboratories has involved over 1,000 minority students in their summer lab internships and currently has committed itself to support 60 minority students from their B.S. through to a Ph.D. in physical sciences/engineering fields (Hawkins, 1988).

The work of the Office of Opportunities in Science (OOS) of the American Association for the Advancement of Science (AAAS) is an exemplar of the kind of efforts that professional science and technology oriented organizations can undertake. The "Linkage Project" of OOS has succeeded in linking together community-based advocacy and service organizations like the National Urban League and the Girls Club of America with the scientific community to foster educational opportunities in science and math for female, minority and disabled youth. The "Minorities in Science Project" has birthed the "MESH work" and "MWIS" - two organizations targeted respectively to minorities in Math, Engineering, Science and Health and Minority Women In Science.

Sources for role models are the memberships of organizations like the National Organization for the Professional Advancement of Black Chemists and Chemical Engineers, the Association of Black Engineers and Applied Scientists, the National Association of Black Physicians, the Association of Black Psychologists, the National Association of Black Physicists, the Organization of Black Scientists, the National Technical Association, the National Action Council for Minorities in Engineering, and the Association of Blacks in Energy (Malcolm et.al., 1976; King in Proceedings, 1989).

Hispanics

Programs specifically focused on increasing Hispanic participation in science, technology, and mathematics fields have expanded in recent years and led to the formulation of specific models for intervention at various levels (Rendon, 1985). Hispanic students face similar obstacles as black students as documented in field studies like those of Patricia MacCorquodale (1980a, 1980b). Looking at eighth and ninth graders in Arizona, she found highly significant differences in white versus Hispanic students' interest in and attitudes toward science. Hispanic females ranked lowest in both categories. MacCorquodale (1983, 1984) has gone on to identify the language spoken at home, academic competence, family orientation, and self-perception, as being key factors in explaining the observed differences. Females perceive the role of the scientist and the nature of science very differently from males. While feedback to females and minorities about their intelligence may be crucial in raising their interests in science, she points out that it may be difficult to effect any significant changes in outlooks since students' self-perceptions develop over many years.

How an intervention program designed to deal with some aspects of this problem might be constructed can be seen in Ortiz-Franco's description of a mathematics-science intervention program for precollege minority students that focuses on the needs of Chicanos and native Americans (Ortiz-Franco, 1981). The MENTE program of the University of the Pacific should be noted in its efforts with migrant farm workers' children (Rodriguez and Gilbert, 1985). The Educational Testing Service and the Hispanic Higher Education Consortium recently collaborated in the production of a program designed to increase Hispanic performance on the PSAT and the National Merit Scholarship Qualifying Test (College Entrance Examination Board, 1988). A counseling guide specifically for counselors of Hispanic students who wish to present options in engineering and the sciences has been produced (Rodriguez and Gallegos, 1981).

Scholarships

The existence of minority science/engineering scholarships for college is also critical if interest in science and technology based careers is to be fostered. It must be noted that very little quantitative and qualitative information exists to determine the kinds of financial and policies necessary to achieve significantly greater minority involvement and success in graduate education (Hauptman, 1986; Nettles, 1987). Current exemplary models are those of the American Geological Institute (1987) and the already discussed NACME and MESA programs.

INCORPORATING MULTI-ETHNIC DIMENSIONS IN LEARNING MATERIALS

The importance of textbooks in the science curriculum has already been noted. As Clark (1985: 678) reminds us: "While being careful not to impose their views upon the students, teachers can take deliberate efforts to see that the students are made aware of the success of brilliant scientists, particularly blacks who work in the area of the students' career choices. This can be done through materials as well as inviting some of these individuals to visit their schools and classrooms". Frameworks and a rationale for such inclusion have been provided by Banks (1981) and by Stewart (this volume). The National Technical Association already exemplifies in its programs the very approach that Clark, Stewart, and Banks advocate. The inclusion of such materials does make a difference as demonstrated by 46 preservice teachers enrolled in a competency based science methods course at Florida International University during the spring of 1979 (Campbell, Hogges, and Murphy, 1980). While the classes were 85 percent non-black, all expressed surprise at the depth and nature of black scientific achievement in America.

Some helpful curriculum materials that look at minorities broadly and their contributions to math, science, and technology are those of the National Coordinating Center for Curriculum Development, SUNY, Stony Brook (Moger, 1977; 1979; discussed in Cheek and Beigel, this volume); the Saint Paul Public Schools (1982); and a college level course (Fausto-Sterling and English, 1985). Hispanics in science and engineering fields are nicely portrayed in Nick and Reyes (1978). Specific curriculum materials suitable for high school students that deal with black scientific and technical achievements include the New Orleans Instruction Center materials (1978), the modules of H. Prentice Baptiste, et. al. (1974), the Cambridge Rindge and Latin School materials (Walcott, 1980), and the Multnomah School District IJ of Portland, OR (Lumpkin, 1985; Adams III, 1985; discussed in this volume by Cheek and Beigel). These consist mainly of biographical vignettes and related activities.

General resource materials that look at black contributions are numerous. Some of the more suitable sources include those of Haber (1970); Klein (1971); Winslow (1974); the National Science Teachers Association (Jenkins, 1975); the Bell System (1978); the U.S. Department of Energy (1979); Jennings (1980); Van Sertima (1984); Green (1985); and Pearson (1985). The National Technical Association features biographical sketches of practicing black technologists in every issue of the **Journal of the National Technical Association.**

Schools must be concerned that interest in science and technology be fostered for all students. Too often the primary and exclusive focus of programs (like those reviewed above) has been simply to increase the pool of qualified talent for existing science and technology career fields. While there is a clear need for such efforts, it must never be forgotten that one-half of all high school graduates do not go on to college (William T. Grant Foundation, 1988a; 1988b). These students deserve and have the capacity to thrive in learning situations properly structured and sensitive to their needs as can be seen in approaches as traditional as St. John's College great books program called "Touchstones" for high school students (Meisal, 1988). Science education must be perceived as relevant and useful not only to the one-half of the student body who will go on to some college education, but to the forgotten other half who will also be taxpayers and citizens. Science, technology, and society education (STS) holds promise of being a vehicle for relevant, useful science learning by all students in urban schools (see Rubba; Waks; and Wiesenmayer in this volume).

SUMMARY AND IMPLICATIONS

Minority students in our urban schools face a plethora of obstacles to school success. Some of these factors are social or economic in nature and can only be addressed by long term restructuring of American society. These factors strongly influence student motivations. Others are directly within the control of the educational system. There is good evidence that if teachers, administrators, and students can be mobilized to collectively attack clearly delineated educational problems, positive changes can result. Within the area of science education numerous salient points emerge from this study as touchstones for effective programs to address the pressing problems of underachievement of minority students in large urban school districts.

Implications for Educators and Administrators

1. Concrete examples of scientific and technical applications in urban contexts need to be emphasized.

2. The outstanding contributions of minority scientists, engineers, and technologists to American scientific and technical enterprise need to be integrated in science curricula for urban students. This should not be limited merely to historic figures, but must include practicing scientists and technologists.

3. Careers in scientific and technical fields and details about necessary middle and high school preparation for those seeking such careers must be highlighted.

4. Students need to be involved in local, community-based scientific and technological issues and taught the necessary communication and analytical skills to make their voices heard in decisions.

5. Minority role models need to be actively engaged in the science education process in schools through classroom visits, field trips to work sites, and internship programs for students of promising abilities in math and science. The role models are needed for all students at all grade levels.

6. The unique contributions that each minority member can make to the society at large needs to be emphasized and concrete expression given to such beliefs through focused activities related to scientific and technical issues of the urban environment.

7. Greater attention to stimulating interest in science and technology must be focused on the upper elementary and early middle school years. Intervention at the high school level by itself is too little, too late.

8. Greater teacher awareness of the unique problems of urban minority students and strategies to deal with these problems within the context of learning situations is required.

9. Greater attention to multicultural orientation and sustained sensitization of teachers through both preservice and in-service activities is essential if insidious prejudice is to be effectively countered and academic achievement opportunities offered for all students.

10. Important scientific and technological concepts germane to urban areas should be interwoven throughout all levels and traditional disciplines. Multidisciplinary perspectives coupled with consistent rather than intermittent coverage of key concepts should facilitate conceptual integration of science and technology concepts in the mind of the urban minority student.

Implications for Researchers

1. Longitudinal studies of minority students from middle school through college levels are desperately needed.

2. Increased attention to identifying key factors for successful minority programming and the manner in which such factors interact.

3. Greater attention to confounding variables and attendant distrust of "easy" answers in research projects.

4. Closer investigation of the undergraduate-graduate school transition for minority students.

5. Need for increased researcher familiarity with multicultural differences and research paradigms and measurement instruments that are not ethnocentric.

Implications for Professional Organizations and Funding Agencies

1. Partnerships between science and math educators, industry, community organizations, colleges and trade schools, and professional scientific and technical organizations need to be fostered and long range programs funded to address problems that minority youth face in science and math education.

2. Increased funding and attention to elementary and middle school programs for minority students.

3. Long-term funding commitment to intervention programs extending far beyond the innovation stage.

4. Greater involvement of minority professionals in the education process through both school and community programs.

5. Greater sensitization of majority member professionals to the specific needs/aspirations of minority students.

6. Selecting dispersion of funding to those programs with proven track records with a view toward creating programs rational in scope and effect.

Instruction within an STS framework appears to offer great utility in addressing some of these points. Ideally such instruction should not be left to any single course in high school but should be an integrative principle for classes from elementary through high schools. This suggests that administrators and teachers will need special orientation to an STS approach as it relates to their specific discipline and/or teaching responsibility. While STS instruction will certainly not be a panacea to solve all problems of minority students in urban environments, STS instruction should make science learning more relevant and engaged for urban minority students. It should also lead to increased citizen involvement in the future as students exposed to STS education are more likely to be aware and involved in local STS issues.

BIBLIOGRAPHY

Adams III, Hunter Havelin, African and African-American Contributions to Science and Technology, Multnomah School District IJ, Portland, OR, 1985.

Alamprese, Judith A., Managing Together: Handbook of District and High School Practices Toward Excellence, U. S. Department of Education, Washington, D.C., 1986.

American Geological Institute, The Minority Participation Scholarship Program of the American Geological Institute, Alexandria, VA, 1987.

Anderson, Roedean S., "An analysis of opinions from black scientists and the responses of elementary school teachers concerning science education for inner-city youth", Ph.D. dissertation, Walden University, 1979.

Andersen, Tom, Sheryl Barta, "Multilcultural, nonsexist education in Iowa schools: math and science", Iowa State Department of Public Instruction, Des Moines, 1981.

Ascher, Carol, "Increasing science achievement in disadvantaged students (ERIC/CUE report)", Urban Review, 17(4): 279-84, 1985.

Association of Science-Technology Centers, Natural Partners: How Science Centers and Community Groups Can Team Up to Increase Science Literacy, Washington, D.C., 1987.

Atkinson, D.R., M. J. Furlong, W. C. Poston, "Afro-American preferences for counselor characteristics", Journal of Counseling Psychology, 33:326-330, 1986.

Atwater, Mary M., "We are leaving our minority students behind", The Science Teacher, 53: 54-8, 1986.

Atwood, Nancy K., William J. Doherty, "Toward equity and excellence in math and science education", Urban Review, 16(4): 235-48, 1984.

Azios, Maria Leticia, et.al., Teaching English as a Second Language: A Handbook for Science Curriculum, Houston Independent School District, Secondary Level, Houston, 1975.

Banks, James A., "Multicultural education: development, paradigms, and goals", in J.A. Banks, Ed., Education in the Eighties: Multiethnic Education, National Educational Association, Washington, D.C., 1981.

Baptiste, H. Prentice, et. al., Science History Module: Science and Technology Contributions by Afro-Americans in the United States, ERIC (ED 184 988), 1974.

Baratz-Snowden, Joan, "Where are the minority teachers?", in Audrey B. Champagne, Ed., This Year in School Science 1988 - Science Teaching: Making the System Work", American Association for the Advancement of Science, Washington, D.C., 1988.

Bell, Y.R., M.K. Jackson, "Assertive behavior among black college students", The Journal of Black Psychology, 11(1): 19-27, 1984.

Bell System, Minorities in Engineering, Bell System, NY, 1978.

Benderson, Albert, "Researchers focus on student disinterest in math, science, and engineering courses", ETS Developments, 34(1): 3-5, 1988.

Bengis, Laraine,Urban Project Student Profile: A Longitudinal Analysis from the Ninth through the Eleventh Grade, June 1981-June 1983,City University of New York, New York Research Unit for Special Programs, New York, 1983.

Benjamin, Lois, "Black women achievers: an isolated elite", Sociological Inquiry, 52(2): 141-151, 1982.

Berry, Richard M.,Melvin Thompson, Resources Supporting Scientific Activities at Predominantly Black Colleges and Universities. A Special Report,National Science Foundation, Washington, D.C., 1982.

Berryman, Sue E., Who Will Do Science? Trends, and Their Causes in Minority and Female Representation Among Holders of Advanced Degrees in Science and Mathematics. A Special Report.,Rockefeller Foundation, New York, 1983.

Brady, M.L., "Understanding the minority children in the American educational system", Education, 105:21-33, 1984.

Brookover, W.B., "Can we make schools effective for minority students?", Journal of Negro Education, 54:257-68, 1985.

Brown, Faith K., David P. Butts, Eds., Science Teaching: A Profession Speaks, National Science Teachers Association, Washington, DC, 1983.

Brown, Frank B., et. al., Education for Responsible Citizenship - The Report of the National Task Force on Citizenship Education, McGraw-Hill Book Co., New York, 1977.

Brown, Shirley Vining, Minorities in the Graduate Education Pipeline, Educational Testing Service, Princeton, NJ, 1987.

________________________, Increasing Minority Faculty: An Elusive Goal, Educational Testing Service, Princeton, NJ, 1988.

Bureau of the Census, 1980 Census of Population- Supplementary Report: "Summary Characteristics of the Black Population for States and Selected Counties and Places: 1980", U.S. Department of Commerce, Washington, D.C., 1987.

Campbell, Richard L., Ralph Hogges, Dennis Murphy, "The effect of information about famous black scientists on the close-mindedness of preservice teachers", NARST, April 1980, Boston, ERIC (ED186 252), 1980.

Campbell, Richard L., Robert Farrell, "The identification of competencies for multicultural teacher education", The Negro Educational Review, 36 (3-4): 137-144, 1985. Campbell, Patricia B., "What's a nice girl like you doing in a math class?", Phi Delta Kappan, 67(7): 516-520, 1986.

Cervantes, Robert A., "Ethnocentric pedagogy and minority student growth: implications for the common school", Education and Urban Society, 16: 274-93, 1984.

Chipman, Susan F., Veronica G. Thomas, "The participation of women and minorities in mathematical, scientific, and technical fields", Review of Research in Education, Ed. Ernest Z. Rothkopf, Vol. 14, American Education Research Association, Washington, D.C., 1987.

Clewell, Beatriz Chu, "What works and why: research and theoretical bases of intervention programs in math and science for minority and female middle school students", in Students and Science Learning - Papers from the 1987 National Forum for School Science, Eds., Audrey B. Champagne, Leslie A. Hornig, American Association for the Advancement of Science, Washington, D.C., 1987.

________________________, Margaret Thorpe, Bernice Anderson, Intervention Programs in Math, Science, and Computer Science for Minority and Female Students in Grades Four through Eight, Educational Testing Service, Princeton, NJ, 1988.

Clifton, Rodney A., R.P. Perry, K. Parsonson, S. Hryniuk, "Effects of ethnicity and sex on teachers' expectations of junior high school students", Sociology of Education, 59(1): 58-67, 1986.

Clark, Julia V., "The status of science and mathematics in historically black colleges and universities" Science Education, 69: 673-79, 1985.

College Entrance Examination Board, Equality and Excellence - the Educational Status of Black Americans, New York, 1985.

________________________, Preparing for the PSAT/NMSQT for Hispanic High School Students, New York, 1988.

Cole, Michael, Peg Griffin, Eds., Contextual Factors in Education, Wisconsin Center for Educational Research, University of Wisconsin-Madison, Madison, 1987.

Cole, Beverly, "The state of education for black Americans", in Annual Editions - Education 85/86, Ed., Fred Schultz, The Duskin Pub. Co., Guilford, CT, 1985.

Counsel of Great City Schools, Challenges to Urban Education: Results in the Making, Washington, D.C., 1986.

Crowley, Michael F., Melissa J. Lane, Women and Minorities in Science and Engineering, National Science Foundation, Washington, D.C., 1986.

________________________, et. al., Women and Minorities in Science and Engineering, National Science Foundation, Washington, D.C., 1984.

Crowley, Michael F., et. al., Women and Minorities in Science and Engineering, National Science Foundation, Washington, D.C., 1982.

Cummins, Jim, "Empowering minority students: a framework for intervention", Harvard Education Review, 56: 18-36, 1986.

Dawkins, P., "Black students' occupational expectations - a national study of the impact of school desegregation", Urban Education, 18 (1): 98-113, 1983.

Ellis, Ronald S., Alene L. Smith, "The summer institute to encourage the study of mathematics and science in urban secondary schools", The Journal of Negro Education, 56(4): 570-579, 1987.

Epps, Edgar G., Kenneth W. Jackson, Educational and Occupational Aspirations and Early Attainment of Black Males and Females, Southern Education Foundation, Atlanta, 1985.

ERIC, Hispanics, Engineering, and the Sciences: A Counseling Guide, ERIC Clearinghouse on Rural Education and Small Schools, Las Cruces, N.M., 1981.

Erickson, Frederick, "Culture difference and science education", Urban Review, 18(2): 117-24, 1986.

Fausto-Sterling, Anne, Lydia L. English, Women and Minorities in Science: An Interdisciplinary Course, Center for Research for Women, Wellesley College, Wellesley, MA, 1985.

Fordham, Signithia, John U. Ogbu, "Black students' school success; coping with the burden of 'acting white'", Urban Review,, 18(3): 176-206, 1986.

Foster, John T. Jr., Victoria E. Warner, "Lessons from the experience of upward mobility", The Hampton University Journal of Ethnic Studies, 12(1): 31-44, 1985.

Friedlander, Jack, Science Education for Women and Minorities in an Urban Community College, Center for the Study of Community Colleges, Los Angeles, 1981.

Fuller, James W., Robert K. James, "A study of the inclusion of the contributions of black scientists in selected secondary science programs", School Science and Mathematics, 80(4): 287-290, 1980.

Gallagher, James J., George Dawson, Eds., Science Education and Cultural Environments in the Americas. Report of the Inter-American Seminar on Science Education (Panama City, Panama, December 10-14, 1984),National Science Foundation, Washington, D.C., 1986.

Goggins, Ellen D., Joy S. Lindbeck, "High school science enrollment of black students",Journal of Research in Science Teaching, 23(3):251-62, 1986.

Graham, S., "Can attribution theory tell us something about motivation in blacks?", Educational Psychologist, 23(1): 3-21, 1988.

Grant, C.A., G.W. Grant, "Increasing the educational opportunties of black students by training teachers in multicultural curriculum development", The Western Journal of Black Studies, 10(1): 29-33, 1984.

Grant, Linda, "Black females' 'place' in desegregated classrooms", Sociology of Education, 57(2): 98-111, 1984.

Green, R. L., Ed., A Salute to Black Scientists and Inventors, Empak Enterprises, Chicago, 1985.

Grew, Pricilla C., "New directions for intervention: Report from the National Science Foundation Committee on equal opportunities in science and technology", Paper presented at AERA, April 16-20, 1986, ERIC (ED269 256), 1986.

Habarth, Theodore J., Journey - A Motivational and Career Guidance Series for Teenage Students, National Consortium for Graduate Degrees for Minorities in Engineering Inc., Laurel, MD, 1988.

Haber, Lewis, Black Pioneers in Science and Invention, Harcourt, Brace, & Jovanovich, New York, 1970.

Hall, John H., Long-term Activities for Minority Institutions in Science and Technology, Atlanta University Center Inc., Atlanta, 1984.

Hall, Paula Q., Shirley M. Malcolm, Minority Women in Science--A Statistical View, National Network of Minority Women in Science, Office of Opportunities in Science, American Association for the Advancement of Science, Washington, D.C., 1982.

_______________________, Problems and Solutions in the Education, Employment, and Personal Choices of Minority Women in Science, American Association for the Advancement of Science, Washington, D.C., 1981.

Hall, V.C., S. Merkel, A. Howe, N. Lederman, "Behavior, motivation and achievement in desegregated junior high school science classes", Journal of Educational Psychology, 78(2): 108-115, 1986.

Harms, Norris C., Robert E. Yager, What Research Says to the Science Teacher, Vol. 3, NSTA, Washington, D.C., 1981.

Hauptman, A.M., Students in Graduate and Professional Education: What We Know and Need to Know, The Association of American Universities, Washington, D.C., 1986.

Hawkins, W. Lincoln, lecture, New Jersey Institute of Technology, Newark, NJ, May 24, 1988.

Hilliard, Asa, Alternatives to IQ Testing: An Approach to the Identification of Gifted Minority Children, California State Department of Education, Sacramento, 1976.

Hodgkinson, Harold L., All One System - Demographics of Education, Kindergarten through Graduate School, The Institute for Educational Leadership Inc., Washington, D.C., 1985.

Holmes, Barbara J., Black Students' Performance in the National Assessment of Science and Mathematics, Educational Commission of the States, Denver, 1980.

________________________, "Black students' performance in the National Assessments of Science and Mathematics", Journal of Negro Education, 51(4): 392-405, 1982.

Humphreys, Sheila M., Ed., Women and Minorities in Science-Strategies for Increasing Participation, Westview Press, Boulder, 1982.

Jacobowitz, Tina, "Factors associated with science career preferences of black junior high school students", ERIC (ED212 851), 1980.

________________________, "Relationship of sex, achievement, and science self-concept to the science career preferences of black students", Journal of Research in Science Teaching, 20(7): 621-628, 1983.

Jenkins, Edward S., Ed., American Black Scientists and Inventors, National Science Teachers Association, Washington, D.C., 1975.

Jennings, Don, et. al., Designing the Future, Don Jennings & Assoc., Lakewood, CO, 1980.

Jones, L.V., "White-black achievement differences", American Psychologist, 39(11): 1207-1213, 1984.

Kahle, Jane Butler, Double Dilemna: Minorities and Women in Science Education, Purdue University, West Lafayette, IN, 1982.

________________________, "Factors affecting minority participation and success in science", What Research Says to the Science Teacher, Vol. 4, Ed. Robert E. Yager, NSTA, Washington, D.C., 1982

Klein, Aaron, The Hidden Contributors, Doubleday & Co., Garden City, New York, 1971.

Kreinberg, Nancy, "The math and science education of women and minorities: the California perspective", Paper presented at AERA Northern California Regional Conference, May 1, 1982, ERIC (ED218 114), 1982.

Kutsick, Koressa, Linda Jackson, "Enhancing self-efficacy in minority youth: a group technique", Psychology in the Schools, 25(2): 183-186, 1988.

Lehman, James D., Charlotte Carter, Jane Butler Kahle, "Concept mapping, Vee mapping, and achievement: results of a field study with black high school students", Journal of Research in Science Teaching, 22(7): 663-673, 1985.

Levine, Daniel U., Rayna R. Levine, Eugene E. Eubanks, "Successful implementation of instruction at inner-city schools", The Journal of Negro Education, 54(3): 313-332, 1985.

Ley, David, The Black Inner City as Frontier Outpost- Images and Behavior of a Philadelphia Neighborhood, Association of American Geographers, Washington, D.C., 1974.

Lezotte, Lawrence W., Beverly A. Bancroft, "School improvement based on effective schools research: a promising approach for economically disadvantaged and minority students", Journal of Negro Education, 54: 301-12, 1985.

Lieberson, Stanley, A Piece of the Pie: Blacks and White Immigrants Since 1880, The University of California Press, Berkeley, 1980.

Lockard, David, "Science and technology education: developments under review", Prospects, 15(4): 523-33, 1985.

Lumpkin, Beatrice, African and African-American Contributions to Mathematics, Multnomah School District IJ, Portland, OR, 1985.

MacCorquodale, Patricia, "Interest in science courses and careers: a comparison of Mexican-American and Anglo students", Paper presented at the Conference of the Society for the Advancement of Chicanos and Native Americans in Science, Albuquerque, NM, November 1980, ERIC (ED200 354), 1980a.

______________________, "Psycho-social influences on the accomplishments of Mexican-American students", Paper presented at the American Association of School Administrators Instructional Leadership Conference, Chicago, July 1980, ERIC (ED200 355), 1980b.

______________________, Social Influences on the Participation of Mexican-American Women in Science, National Institute of Education, Washington, D.C., 1983.

MacCorquodale, Patricia, "Self-image, science and math: does the image of the 'scientist' keep girls and minorities from pursuing science and math?", Paper presented at the Annual Meeting of the American Sociological Association, San Antonio, August 27-31, 1984, ERIC (ED253 493), 1984.

Maeroff, Gene I., "Magnet schools used as a tool for equality", in Annual Editions - Education 85/86, Ed., Fred Schultz, The Duskin Pub. Co., Guilford, CT, 1985.

Malcolm, Shirley M., John Cownie, Janet W. Brown, Programs in Science for Minority Students, 1960-1975, Office of Opportunties in Science, American Association for the Advancement of Science, Washington, D.C., 1976.

____________________, Equity and Excellence: Compatible Goals. An Assessment of Programs that Facilitate Increased Access and Achievement of Females and Minorites in K-12 Mathematics and Science Education, Office of Opportunities in Science, American Association for the Advancement of Science, Washington, D.C., 1984.

Marchand, Susan G., Ed., Strategies for Equality: Mathematics/Science. Vol IV., Training Institute for Sex Desegregation of the Public Schools, Rutgers University, New Brunswick, 1980.

Marcus, Sheldon, Thomas A. Mulkeen, "The new urban demography: implications for the schools", Education in Urban Society, 16: 395-517, 1984.

Marinez, Diana, Bernard Ortiz de Montellano, "Teaching culturally relevant science", Paper presented at the Michigan Annual Hispanic Education Conference, Dearborn, MI, May 13-14, 1983, ERIC (ED259 035), 1983.

Matyas, Marsha Lakes, "Science career interests, attitudes, abilities, and anxiety among secondary school students; the effects of gender, race/ethnicity, and school type/location", Paper presented at NARST, April 28, 1984, ERIC (ED251 309), 1984.

Meisol, Patricia, "Learning to learn: discussion approach gets results", The Baltimore Sun, Education section, July 31, 1988.

MESA, "Invest in Your Company's Future - Invest in MESA", Lawrence Hall of Science, Berkeley, CA, 1988.

MESA Newsletter, 11(1): 2-3, 1988.

MESA Network News, Spring, 1988.

Moger, S., Ed., Minority Contributions: I and II, National Coordinating Center for Curriculum Development, State University of New York, Stony Brook, 1977, 1979.

Napier, J.D., J.P. Riley Jr., "Relationship between affective determinants and achievement in science for seventeen years olds", Journal of Research in Science Teaching, 22: 365-83, 1985.

National Science Foundation, Minority Institutions Science Improvement Project (MISIP): A Brief History 1972-1980, National Science Foundation, Washington, D.C., 1981.

Nettles, Michael, Financial Aid and Minority Participation in Graduate Education, Educational Testing Service, Princeton, NJ, 1987.

New Orleans Instruction Center, Afro-American Contributions to Science, Division of Instruction, New Orleans, 1978.

Nick, D., C. Reyes, A Salute to Hispanic Americans in Science and Engineering, DNR Assoc., Alexandria, 1978.

Nobles, Wade, "Psychometrics and africa-american reality: a question of cultural antimony", The Negro Educational Review, 38(2-3): 45-55, 1987.

Ogbu, John U., The Next Generation: An Ethnography of Education in an Urban Neighborhood, Academic Press, New York, 1974.

Ogbu, John U., Minority Education and Caste, the American System in Cross- Cultural Perspective, Academic Press, New York, 1978.

_________________________, "Cultural discontinuities and schooling", Anthropology and Education Quarterly, 13: 190-207, 1982.

_________________________, "Cultural-ecological influences on minority school learning", Language Arts, 62(8): 860-69, 1985.

_________________________, "The consequences of the American caste system", The School Achievement of Minority Children-New Perspectives, Ed. Ulric Neisser, Lawrence Erlbaum Assoc. Pub., Hillsdale, NJ, 1986.

Ortiz-Franco, Luis, "Suggestions for increasing the participation of minorites in scientific research", April 1981, ERIC (ED210 152), 1981.

Patchen, Martin, Gerhard Hofmann, William R. Brown, "Academic performance of black high school students under different conditions of contact with white peers", Sociology of Education, 53(1): 33-51, 1980.

Payne, B.D., "The relationship of test anxiety and answer-changing behavior: an analysis by race and sex", Measurement and Evaluation in Guidance, 16(4): 205-210, 1984.

Pearson, Willie Jr., Black Scientists, White Society and Colorless Science: A Study of Universalism in American Science, Associated Faculty Press, New York, 1985.

Perlman, Joel, "A piece of the educational pie: reflections and new evidence on black and immigrant schooling since 1880", Sociology of Education, 60(1): 54-61, 1987.

Perrone, Vito, et. al., Portraits of High Schools, A Supplement to High School: A Report on Secondary Education in America, The Carnegie Foundation for the Advancement of Teaching, Princeton University Press, Lawrenceville, N.J., 1985.

Pick, Grant, "The life of Johnny Washington: Noates from the underclass", Utne Reader, Nov./Dec. 1988, pp. 40-48.

Ponterotto, Joseph G., Charlene M. Alexander, James A. Hinkson, "Afro-american preferences for counselor characteristics: a replication and extension", Journal of Counseling Psychology, 35(2): 175-182, 1988.

Ponzio, Richard,"Science education for the eighties: minority participation", Paper presented at the AERA, April 1981, ERIC (ED201 534), 1981.

Powell, Richard R., Jesus Garcia, "The portrayal of minorities and women in selected elementary science series", Journal of Research in Science Teaching, 22(6): 519-533, 1985.

Powledge, Tabitha M., "Walter Massey on being a black scientist", The AAAS Observer, 2: 8-9, 4 November 1988.

Proceedings of the National Conference on Pre-college Education of Minorities in Science and Engineering, May 22-25, 1988, New Jersey Institute of Technology, Newark, NJ, 1989.

Project on Equal Education Rights (PEER), PEER Report, Now Legal Defense and Education Fund, Washington, D.C., 1983.

Pruitt, Anne S., Ed., In Pursuit of Equality in Higher Education, General Hall Inc. Pub., Dix Hills, NJ, 1987.

Quinn, Mary Ellen, Carolyn Kessler, "Science Education and bilingualism", Paper presented at the NARST, April 1980, ERIC (ED193 024), 1980.

Rakow, Steven J., "Minority students in science - perspectives from 1981-1982 National Assessment in Science", Urban Education, 20(1):103-113, 1985.

________________________, Constance L. Walker, "The status of Hispanic American students in science: achievement and exposure", Science Education, 69: 557-65, 1985.

Raywid, Mary A., "Making school work for the new majority", Journal of Negro Education, 56:221-28, 1987.

Rendon, Laura I., Preparing Mexican Americans for Mathematics and Science Based Fields: A Guide for Developing School and College Intervention Models, ERIC Clearinghouse on Rural Education and Small Schools, Las Cruces, N.M., 1985.

Research Triangle Institute, Report of the 1985-86 National Surveys of Science and Mathematics Education, Research Triangle Park, North Carolina, 1988.

Resource Center for Science and Engineering, Conference on Issues in Minority Science Education, Proceedings, March 15-17, 1979, Resource Center for Science and Engineering, Atlanta University, Atlanta, 1979.

Rodriguez, Andres F., Michael B. Gilbert, "MENTE spells success for migrant students", The Science Teacher, 52(7): 29-31, 1985.

Rodriguez, Roy C., Robert Gallegos, Hispanics, Engineering, and the Sciences: A Counseling Guide, ERIC Clearinghouse on Rural Education and Small Schools, Las Cruces, NM, 1981.

________________________, Irene V. Rodriguez, "Attracting and retraining Hispanics in math and science teacher education", Teacher Education, 21:9-15, 1986.

Rothman, Robert, "U.S. fares poorly on science test", Education Week, March 9, 1988.

St. Paul Public Schools, Minority Women in Math and Science, Urban Affairs Department, Saint Paul Public Schools, St. Paul, MN, 1982.

Salters, Charles R., et.al., "The relationship between attitude toward science, science self-concept, and other variables of occupational choice to the science career choices of black college students", Morgan State University, Baltimore, MD, 1987, ERIC (ED280 736), 1987.

Science, "Science at Duke in black and white", Science, 240:877, 1988.

Scott-Jones, Diane, Maxine L. Clark, "The school experiences of black girls: the interaction of gender, race, and socioeconomic status", Phi Delta Kappan, 67(7): 520-526, 1986.

Shade, Barbara J., "Afro-american cognitive style: a variable in school success?", Review of Educational Research, 52(2): 219-244, 1982.

________________________, "Is there an afro-american cognitive style?", The Journal of Black Psychology, 13(1): 13-16, 1986.

________________________, Patricia A. Edwards, "Ecological correlates of the educative style of Afro-American children", The Journal of Negro Education, 56(1): 88-99, 1987.

Simmons, W., "The relationship between academic status and future expectations among low-income blacks", The Journal of Black 7-16, 1979.

Simpson, R.D., J.S. Oliver, "Attitude toward science and achievement motivation profiles of male and female science students in grades six through ten', Science Education, 69(4): 511-526, 1985.

Slaughter, Diana T., Edgar G. Epps, "The home environment and academic achievement of black American children and youth: an overview", The Journal of Negro Education, 56(1): 3-20, 1987a.

________________________, "The black child's home environment and student achievement", The Journal of Negro Education, 56(1): 1-2, 1987b.

Smith, R.R., R. Lewis, "Race as a self-schema affecting recall in black children", The Journal of Black Psychology, 12(1):15-29, 1985.

Stroman, C.A., "The socialization influence of television on children", Journal of Black Studies, 15(1): 79-100, 1984.

Student Science Service, Washington, D.C., 1987, personal communication.

Subcommittee on Science, Research, and Technology, Symposium on Minorities and Women in Science and Technology, Serial AA, Committee on Science and Technology, U.S. House of Representatives, 97th Congress, Washington, D.C., 1982.

Suiter, Marilyn J., Special Programs/Proposals, The American Geological Institute, Alexandria, VA, personal communication, March 2, 1988.

Task Force on Black Academic and Cultural Excellence, Saving the African-American Child, National Alliance of Black School Educators Inc., Washington, D.C., 1984.

Thelen, Judith N., Improving Reading in Science, International Reading Association, Newark, DE, 2nd ed., 1984.

Thier, Herbert D., compiler, SCIS and the Disadvantaged: A Report from the Field, Science Curriculum Improvement Study, The University of California, Berkeley, 1970.

Thomas, Gail E., "Cultivating the interest of women and minorites in high school mathematics and science", Science Education, 70(1):31-43,1986.

Tobin, Kenneth, "Forces which shape the implemented curriculum in high school science and mathematics", Teaching and Teacher Education, 3(4): 287-298, 1987.

Toohey, K., "Minority educational failure: is dialect a factor?", Curriculum Inquiry, 16: 127-45, 1986.

Trowbridge, Leslie W., R. W. Bybee, R. B. Sund, Becoming a Secondary School Science Teacher, Charles E. Merrill, Columbus, 1981.

Turner, Henrie M., et. al., Factors Influencing Persistence/Achievement in the Sciences and Health Professions by Black High School and College Women. Final Report, National Institute of Education, Washington, D.C., 1983.

United States Congress, Office of Technology Assessment, Educating Scientists and Engineers: Grade School to Grad School, United States Government Printing Office, Washington, D.C., 1988.

United States Department of Commerce, 1987 Statistical Abstract of the U.S., USGPO, Washington, D.C., 1986.

United States Department of Education, Reaching for Excellence: An Effective Schools Sourcebook, USGPO, Washington, D.C., 1985.

________________________, Schools that Work - Educating Disadvantaged Children, USGPO, Washington, D.C., 1987.

U.S. Department of Energy, Black Contributors to Science and Energy Technology, Office of Public Affairs, U.S. Department of Energy, Washington, DC, [No. 0035(79)], 1979.

Unks, Gerald, "The new demography: implications for the school curriculum", Education in Urban Society, 16: 443-62, 1984.

Van Sertima, Ivan, Ed., Blacks in Science: Ancient and Modern, Transaction Books, New York, 1984.

Vetter, Betty, "Who gets science doctorates today?", The AAAS Observer, 2:10, 4 November 1988.

Walcott, Phyllis B., Black Scientists and Inventors in the United States: 1731-1980, Curriculum Guide, Department of Science, Cambridge Rindge and Latin School, Cambridge, MA, 1980.

Walker, Westbrook A., "The analysis of a tailor-made curriculum and its impact upon 5th and 6th grade minorities and female children", Paper presented at the annual NARST, Boston, Ma., April 11-13, 1980, ERIC (ED184 825), 1980.

Walsh, John, "Spotlight brighter on minorities in science", Science, 238: 265-66, 1987.

________________________, "U.S. science students near foot of class", Science, 239: 1237, 1988.

William T. Grant Foundation Commission on Work, Family, and Citizenship, "The forgotten half: non-college bound youth in America", Phi Delta Kappan, 69(6): 409-414, 1988a.

________________________, The Forgotten Half: Non-College Bound Youth in America, Washington, D.C., 1988.

Williams, James D., Ed., The State of Black America 1984, National Urban League Inc., Washington, D.C., 1984.

Williams, Silvia B., "A comparative study of black dropouts and black urban high school graduates in an urban public school system", Education in Urban Society, 19(3): 311-19, 1987.

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Willig, A.C., D. L. Harnisch, K.T. Hill, M. L. Maehr, "Socio-cultural and educational correlates of success-failure attribution and evaluation anxiety in the school setting for black, hispanic, and anglo children", American Educational Research Journal, 20(3): 385-410, 1983.

Wilson, Karen R., Walter R. Allen, "Explaining the educational attainment of young black adults: critical familial and extra-familial influences", Journal of Negro Education, 56(1): 64-76, 1987.

Wilson, Bryan, Cultural Contexts of Science and Math Education: A Bibliographic Guide, Center for Studies in Science Education, Leeds University, Leeds, England, 1981.

Winfield, Linda F., "Teacher beliefs toward academically at risk students in inner urban schools", Urban Review, 4: 253-68, 1986.

Winslow, Eugene, Black Americans in Science and Engineering: Contributions of Past and Present, Afro-American Publishing Co. and General Electric, New York, 1974.

Wooldridge, P., C.L. Richman, "Teachers' choice of punishment as a function of a student's gender, age, race, and IQ level", The Journal of School Psychology, 23: 19-29, 1985.

Wright, D.J., "Responding to the needs of today's minority students (symposium)", New Directions in Student Services, 38: 1-109, 1987.

Yin, Robert K., J. Lynne White, Managing for Excellence in Urban High Schools: District and School Roles, U.S. Department of Education, Washington, DC, 1986.

Yore, Larry D., "What research says about science textbooks, science reading and science reading instruction: a research agenda", Paper presented at NARST, San Francisco, March 28-April 1, 1986, ERIC (ED269 243), 1986.

Yore, Larry D., James A. Shymansky, "Reading, understanding, remembering, and using information in written science materials", Paper presented at Annual meeting of Association for the Education of Teachers in Science, Cincinnati, OH, April 18-21, 1985, ERIC (ED258 825), 1985.

IDENTIFYING STS THEMES AND ISSUES IN INNER-CITY EDUCATION: SOME CONCEPTUAL TOOLS

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Science, Technology and Society is not the name for a distinct school subject but a concept of curriculum integration. An integrative curriculum is one that provides specific means for the learners to integrate (a) what is learned from different school subjects or curriculum domains, and (b) what is learned is school with out-of school experiences. STS education has the potential to make this integration possible by means of curriculum units defined around themes which involve several aspects of reality and contain the possibility of unfolding into sub-themes which call for tasks of different nature to be fulfilled. These themes contain or are contained in situations that appear as a problem directly or indirectly affecting the lives of the students to which STS units are intended.

A social problem can be defined as a situation that induces material or psychic suffering for certain segments of the population, or prevents a significant number of members of the society from developing and utilizing their full potential (Eitzen, 1986). These situations involve an imbalance, a discrepancy between what the society--in this case the US society--stands for (equality of opportunity, justice and democracy, environmental health) and the actual conditions of many people within the society (discrimination, political marginalization, poverty, environmental degradation, etc.). Some of these problems--e.g. air pollution, unemployment, drug abuse--are manifest, easily identified and recognized as problems by a number of people. Other problems are latent, not evident or apparent (toxic waste, for example, was not seen as a problem in the 50s but now is recognized as such) (Pavalko, 1986).

While there is an objective reality to social problems--few people would argue that air pollution or famine are not social problems--it is dangerous to define social problems objectively. What is a social problem for one group may be nothing of the sort for another. Teenage pregnancy, for example, is considered as a problem in Western societies; however, groups with different cultural background may consider this phenomenon normal. Likewise, there is often a political dimension in the identification of social problems. Thus, certain situations can be qualified as problematic by groups holding economic or political power, depending on their interests.

Whenever an imbalance has been identified and made subject to normative and value judgement, we may speak of a social concern. The concern indicates the drawing of a distinction between the state of affairs as it is or as it should or could be.

A social concern becomes and issue when uncertainty divides the community. According to Hare (1987), an issue is a particular situation about which "serious and reasonable people disagree and there is no resolution at hand" (p.104). A social issue presupposes the existence of a social problem and of opposing views regarding the manifestations and causes of the problem as well as the possible ways to solve it. The existence of an issue makes it possible to speak of identifying positions. A position is not just a possible standpoint on addressing an identified imbalance, but one which can become attached to the political process.

STS themes and issues in the context of the inner-city

Classic examples of science and technology-related problems in the inner-city are youth unemployment, job displacement, and toxic waste. They are manifest social problems, and, to the extent that few would question their problematic nature, they can be said to be objective. However, not all STS themes can be so easily identified. Because inner-city communities tend to be silent and do not put their demands and concerns through the political system, it is difficult to know (a) what kind of situations are perceived by them as problematic, and (b) the degree of their awareness, if any, regarding the issues directly related to them which are already being discussed in the political arena (usually by "outsiders").

Due to these "ambiguities", STS education in the context of the inner-city must focus not only on situations that have already become issues, but on the identification of those situations that can be made issues. According to HAre (1987), "even well entrenched views [or situations which are taken for granted]... can be challenged, can be made controversial" (p. 105, emphasis added). These situations are generative themes that may or may not become issues as defined above, but have the potential to divide the community.

In the context of the inner-city, STS themes may contain or be contained in what Paulo Freire (1983) refers to as limit-situations that imply limit-acts. A limit situation implies that while there are persons who are directly or indirectly served by certain conditions, others are curbed by them. For example, technological changes in the workplace have led to increases of productivity and profits but have at the same time created unemployment and, in some case, downgraded the skills of the workers. The same technological phenomenon benefits some and victimizes others This an other limit-situations may be perceived by those who are affected by them as impossible boundaries where all possibilities end. However, if examined as realities susceptible of transformation and inquiry, these situation can become boundaries where all possibilities begin. Limit-acts are those directed at negating and changing, rather than passively accepting the "given."

The task of defining the contents of STS education in the inner-city is two-fold. It involves, on one hand, the survey and investigation of issues directly related to the community and, on the other, the identification and analysis of imbalances that can or should become issues in the political arena. The latter is an essential condition if STS education is to make a significant contribution to the political education of these communities.

References

Eitzen, D.S. (1986). Social Problems. Newton: Mass.: Allyn & Bacon.

Freire, P. (1983). Pedagogy of the oppressed. New York: Continuum.

Hare, W. (1987). Open-mindedness in moral education: Three contemporary approach. Journal of Moral Education, 16(2), 99-107.

Pavalko, R.M. (1986) Social problems. Itasca, Ill.: Peacock Publishers.

INTEGRATING STS INTO SCHOOL SCIENCE INSTRUCTION: SALIENCE FOR INNER-CITY POOR AND MINORITY LEARNERS

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In this paper, the author seeks to accomplish four purposes: first, to briefly overview the rational for making STS (Science-Technology-Society), approached from a social responsibility perspective, a part of the science education students receive in school; secondly, to summarize recent relevant research and other literature which has implications for how STS is integrated into school science instruction; thirdly, to suggest a curriculum structure for STS education, per se, and upon which it can be integrated into school science; and lastly, to note the salience of the STS-science amalgam for inner-city poor and minority learners. The early sections of the paper draw heavily upon the text of Rubba and Wiesenmayer (1987).

STS Education: A Rationale Taken from the Social Responsibility Perspective

Since primitive man first used a common object as a tool, humans have been faced with decisions on issues which involve technological developments. The advent of science created opportunities for additional issues. As our science and technology became more complicated, pervasive and powerful, particularly during the past quarter century, the ability to make responsible decisions on science and technology-related societal issues and take action toward their resolution, has gained in importance. A few hundred-thousand years ago a technology-related societal decision might have involved deciding whether to hunt with a club or rock and effected relatively few people. Today, the science and technology-related societal issues, the method selected for resolution, as well as the consequences of these are more momentous, effecting large segments of humankind and the natural ecology for generations, sometimes permanently.

Irrespective of one's gender, race, ethnic background or position within society, today citizens face decisions on issues arising out of the interactions of science, technology, and human values every day of their lives, in areas such as: environmental quality, health and medicine, national security, waste management, and world population -- on issues such as food additive use, energy consumption, waste management, land use, technology in the workplace, sexually transmitted diseases, acid rain, genetic engineering, world hunger, overpopulation, nuclear proliferation, water quality and a myriad of others. Some of those issues confront us more at the personal level (e.g., use of food products which contain certain additives or pesticides, energy consumption), others we face both at the personal level and as members of society (e.g., acid rain, nuclear proliferation, urban decay, water quality).

As members of a democratic society, we have the right, and some would argue that we have the obligation, to participate in the resolution of those issues which effect segments of society or society as a whole. We do so through the election of and communications with governmental representatives, or by direct participation in societal affairs -- by running for office, speaking out at public meetings, joining civic, community and neighborhood groups, doing volunteer work, participating in demonstrations, or contributing money to organizations which sponsor action.

The high level groups which examined the status of science education in the U.S. during the early 1980s (Aaronian and Brinckerhoff, 1980; Harms and Yager, 1981; NSTA, 1982; NSB, 1983) recognized that an ever growing complex of science and technology-related societal issues face humankind, and that thorough consideration and thoughtful action by a large segment of our citizenry will be required if the issues are to be resolved satisfactorily. It also was clear to the panel members, however, that such action is the exception rather than the rule.

Citizen Action or Apathy on STS Issues

American adults show a high level of interest in new inventions and technologies, and place a great deal of faith in their power. At the same time, however, the vast majority of citizens lack the knowledge and capabilities needed to deal with science and technology as they touch our everyday lives, and so, do not. Six out of 10 Americans in 1982 believed that more good than harm has come from science and technology, and that most of the economic and social problems we face will eventually be solved by new technologies (Disinger, 1986; NSB, 1985, p. 142).

This relegation of responsibility for the resolution of science and technology-related societal issues back to technology is alarming. But even more so are its secondary effects. From the broadest perspective, the inability and unwillingness of the majority of citizens to deal head-on with science and technology-related societal issues creates an atmosphere in which action on these issues by individual citizens or groups automatically takes on the hue of radicalism. In addition, it places undue burdens upon those few who take action, opens the door to the influence of special interest and prejudice, and possibly, insures the uncontrolled proliferation of technology and the accompanying problems.

It can be easily argued that those segments of our society which reside in urban areas and which traditionally have not participated in the political process -- inner-city poor and minority individuals -- have the most to loose when societal issues are not addressed. Some of the most pressing science and technology-related societal issues facing humankind, e.g., air and water quality, AIDS, waste management, urban decay, technological displacement from the work place, run rampant in our cities. On the other hand, inner-city poor and minority youngsters have the most to gain from an STS education which can empower them to act on science and technology-related societal issues, and other societal issues.

The high-level groups which examined science education during the early 1980s (Aaronian and Brinckerhoff, 1980; Harms anb Yager, 1981; NSTA, 1982; NSB, 1983), recommended that school science programs move away from the singular emphasis on academic preparation which has dominated K-12 science education since the early 1960s, and give comparable emphasis to helping students develop the abilities needed to act on science and technology as they interface with our everyday lives. The integration of science-technology-society (STS) into the school science curriculum for the purpose of helping learners (future citizens) develop the knowledge, skills and affective qualities needed to take responsible action on science and technology-related societal issues was strongly endorsed.

STS Education -- Incomplete Implementation

While the social responsibility perspective on STS education is the most widely accepted, the few snap-shots we have of the integration of STS into science instruction shows a much less complete implementation. Rubba (1986) and Rubba and Wambaugh (1987), asked secondary (grades 7-12) science teachers from Illinois and biology and life science teachers from Pennsylvania, to identify the science and technology-related societal issues they include in the science courses they considered to be their specialty, and what instructional procedures they were using to do so. The societal issues the teachers reported dealing with were few in number and rather predictable. On average the Illinois teachers reported integrating roughly three science and technology-related societal issues into the science course. Among the Pennsylvania sample the average was five societal issues per course.

Except for pollution related societal issues, which were dealt with in all science courses except physics, the issues varied across the teachers by science area taught. Nonetheless, the societal issues tended to be the high visibility, global or national ones. Land use issues were popular with earth science teachers, as were energy use issues with physical science and general science teachers. Issues related to genetic engineering and the environment were focused upon by the life science, biology and advanced biology teachers. The chemistry and physics teachers centered on STS issues related to nuclear power generation and nuclear warfare. (Rubba, 1986)

Surely, these are some of the most threatening societal issues which face humankind; ones which will require expansive effort and significant resources if they are to be resolve. But, they are not necessarily the science and technology-related societal issues which are of primary, local or regional concern in many sections of the U.S., and so ones with which school age youngsters can easily identify and get involved. For example, few of the science teachers addressed issues related to solid waste management or water quality, locally significant issues across both states. (Rubba, 1986) Science and technology-related societal issues which relate directly to the changing face of America's urban communities, such as, community decay or industrial displacement, were not noted at all in the survey.

The instructional procedures the science teachers used to deal with these societal issues were as limited as the issues were limited in scope and number. The lecture and class discussion approaches dominated both samples responses, with film/slides/video next in order of use followed by the laboratory; these are especially the same instructional procedures the science teachers use to "teach" science concepts. (Rubba, 1986)

Illinois sample members were asked to specify the percentage of science class instructional time they believed should be dedicated to preparing students to deal with science and technology-related societal issues. On the average the teachers recommended 15 percent, a value which is close to those recommended in the report of the first Exeter Conference (Aaronian and Brinckerhoff,1980) and by an NSTA committee (1982). It is interesting, however, that none of the science teachers came close to meeting their own recommendations. (Rubba, 1986)

While it is not claimed that the findings from the two studies are representative of science teachers in general, that suspicion is expressed (Rubba, 1986), based upon the work of Goodlad (1984), Hofwolt (1984) and Bybee and Bonnstetter (1987). Given that preservice and inservice science teacher education, for the most part, has focused since the mid-1950s on helping science teachers develop the capabilities to teach science for the goal of academic preparation (Harms and Yager, 1981), and given the relative newness of STS to school science education, it is highly probable that science teachers are using "traditional" instructional procedures to bring STS into the science classroom simply because they are familiar and comfortable with them. Or, it might be because they believe the discussion, the lecture, audio-visual media and lab exercises are appropriate for STS education. Both speculations imply misconceptions on the part of science teachers concerning the aims of integrating STS into school science instruction (Waks and Prakash, 1985) -- misconceptions founded in the primacy of academic science preparation as the goal of a school science education.

Approximately 25 percent of the science teachers Bybee and Bonnstetter (1987) surveyed reported that they would use STS vignettes -- short, provocative questions or statements about science content-relevant societal issues -- to integrate STS into science courses. Brinckerhoff proposed STS vignettes as the most viable means for science teachers to use in overcoming the three major barriers they face with STS (time, knowledge of STS issues, and lack of instructional materials) in a series of three related articles published in 1985, and has collected vignettes for use in science classes (1986). The value of STS vignettes was not supported, however, in two experiments reported on by Rubba (1988). The use of STS vignettes over a six week period with periodic class discussions had no effect on biology students' awareness of current STS issues, the percieved importance the students assigned to current STS issues, and their achievement levels in science. Rubba warns science teachers who wish to integrate STS into science courses for the purpose of empowering students to take action on STS issues, not to depend solely on STS vignettes. Rather, he recommends use of issue investigation and action strategies which have been shown to have substantially greater effects upon students' awareness of STS issues, plus help them develop action capabilities directly associated with the social responsibility perspective on STS education.

Recent Relevant Literature: An Overview

The STS education literature is rich with papers which tout the virtues of STS education and recommend its inclusion in the school curriculum, e.g., the proceedings of the first and second Technological Literacy Conference (Waks, 1986; 1987). However, the literature is sparse when one seeks empirically-based curricular and instructional guidance on how to integrate STS into school science. This weakness and its possible ramifications have been clearly enumerated (Rubba, 1987a).

Volk (1984), Disinger (1986) and Rubba (1987c) each present arguments which suggest that environmental education is, in fact, STS education. Notwithstanding, there is a substantial body of literature in the area of environmental education (EE), over a decade in the making, which has direct implications for STS integrated into science instruction and approached from the social responsibility viewpoint. Five recent EE studies of responsible environmental action (Klingler, 1980; Ramsey, Hungerford and Tomera, 1981; Sia, Hungerford and Tomera, 1986; Hines, Hungerford and Tomera, 1987; and Ramsey, 1987) and a curriculum goal structure for EE (Hungerford, Peyton and Wilke, 1980), in particular, have significant implications for the integration of STS into science curriculum and instruction.

Selected EE Research

Factors which contribute to responsible environmental behavior (action) have been the topic of intensive study among environmental educators for over a decade. Two studies completed in 1984 by Sia (Sia et al.,1986) and Hines (Hines, Hungerford and Tomera, 1987), sought to consolidate that body of research by determining the contribution made by particular variables noted in the EE literature toward predicting the environmental behavior of responsible citizens.

Sia et al. (1986) examined the contribution made by eight variables prominently noted in the EE literature to responsible environmental action among high and low environmental behavior groups. Members of the Sierra Club and an elderhostel group (the subjects) completed a battery of instruments. Analysis of the data via regression analysis showed seven variables to be statistically significant contributors to responsible environmental action: 1) level of environmental sensitivity, 2) perceived knowledge of environmental action strategies, 3) perceived skill in using environmental action strategies, 4) psychological sex role classification, 5) individual locus of control, 6) group locus of control, and 7) attitude toward pollution. The first three of these variables were found to be responsible for 49.24 percent of the variance in responsible environmental behavior. An eighth variable, belief in technology, was not found to be a statistically significant contributor to responsible environmental behavior.

Hines et al. (1987) conducted a meta-analysis of 128 recent EE studies on responsible environmental action to determine which variables were associated with environmental action and the relative strengths of the relationships. Her analysis revealed six variables to be strongly associated with responsible environmental behavior: 1) verbal commitment (intention) to take action (r=0.49), 2) internal locus of control (r=0.38), 3) environmental efficacy perception (belief in one's ability to help alleviate environmental problems) (r=0.36), 4) attitudes toward the environment (r=0,35), 5) a personal sense of responsibility for the environment (r=0.33), and 6) knowledge about the environment (e.g., ecology) (r=0.30).

From the research of Sia et al. (1986) and Hines et al. (1987) it appears that responsible environmental action is mainly a function of four factors: 1) knowledge of environmental issues, 2) knowledge of specific action strategies which might be applied to resolve an environmental issue, 3) the ability to take action on environmental issues (actually apply the action strategies), and 4) the possession of certain affective qualities and personality attributes. The first three of these four factors, the cognitive ones, were clearly predicted in 1980 by Hungerford, Peyton and Wilke in a set of curriculum goals for EE.

A Curriculum Goal Structure for EE

Hungerford et al. (1980) proposed a curriculum goal structure for EE which had as its superordinate goal the development in citizens of the ability and desire to take responsible environmental actions. Four sequential levels of EE were presented subsidiary to that superordinate goal.

At Level I, the Ecological Foundations Level, EE seeks to provide a learner with, "...sufficient ecological foundations knowledge to permit him/her to eventually make ecologically sound decisions with respect to environmental issues" (p. 43). A list of crucial ecological issues (e.g., ecosystem, homeostatis, limiting factors) are presented within the goal statement.

Level II EE, the Conceptual Awareness Level, is directed at helping learners become cognizant of the variety of environmental issues facing humankind, the role played by differing human values and beliefs in their remediation, but also, that only through citizen action will these issues be resolved.

At Level III of the Hungerford et al. goal structure, the Issue Investigation and Evaluation Level, EE instruction aims to provide learners with the knowledge and skills necessary for them to investigate and evaluate alternative means for the remediation of environmental issues. Instruction is provided in areas, such as, issue identification and investigation, analysis of associated value positions, identification of possible alternative solutions, and the evaluation of these. Then, learners are given an opportunity to put those skills into practice in the investigation and analysis of environmental issues.

Level IV EE, Environmental Action Skills Training and Application, seeks to develop in learners those skills needed to take positive action on environmental issues. Here, learners would gain knowledge about actions which fit into five categories: consumerism, legal, persuasion, political, and physical (eco-management) actions. (Civil actions, such as civil disobedience, are not included.) Learners, also, are provided with opportunities to apply these skills to environmental issues and evaluate their effectiveness.

The affective qualities which were found to be associated with environmental action by Sia et al. (1986) and Hines et al. (1987) were also foreseen in the goal structure, though not as completely as were the other three factors. Environmental sensitivity is noted as being critical to an individual's willingness and ability to investigate and take action of environmental issues. Hungerford and his colleagues suggest that ecological foundations instruction (Level I) be provided to learners prior to and/or concurrent to instruction at the other three levels, with the instruction at the latter three levels presented either sequentially or in an integrated fashion. (Hungerford et al., 1980)

The content validity of the Hungerford et al. (1980) goals structure for EE was originally confirmed by a panel of experts. Empirical test of its construct validity was provided by Ramsey in 1979 (Ramsey, Hungerford and Tomera, 1981) and Klingler (1980). In both studies the effects of EE instruction at the different goal levels were compared on the environmental actions taken by junior high school students.

Each study involved three treatments, each lasting one semester: one group received "environmental case study instruction" limited to Goal Levels I and II; a second group received "environmental issue investigation and action instruction" which included Goal Levels I through IV; and a third group served as a control, and so, received life science instruction. The results revealed that those students who received the environmental issue investigation training and action instruction, which included opportunities to apply those skills to an environmental issue, showed statistically significant higher levels of overt environmental action (actions independent of class activities) than did the students in the other two groups. A follow-up three years later by Ramsey of the students in his study revealed that a difference in the number of actions taken continued to exist.

Recently, Ramsey (1987) compared the effects of environmental issue investigation and action instruction to science instruction among seventh grade students' over a 15 week period. Seven student variables were examined in the study: overt environmental behavior, individual locus of control, group locus of control, knowledge of environmental action, environmental sensitivity, perceived knowledge of environmental action, and perceived skill in the use of environmental action strategies. Statistically significant differences between the students in the two treatment groups (each involving multiple classrooms) in favor of the EE groups were revealed on all variables except environmental sensitivity. Ramsey's findings support and extend his previous research on instructional factors leading to action on societal issues.

Implications for STS Education

The work in EE of Hungerford et al. (1980), Ramsey et al. (1981), Klingler (1980), Sia et al. (1986), Hines et al. (1987) and Ramsey (1987) has powerful implications for STS approached from the social responsibility perspective. This literature strongly suggests that if by integrating STS into science instruction we aim to help students develop the capabilitiesand willingness to make discriminating decisions on science and technology-related societal issues, and take action on those decisions, then the STS curriculum and instruction cannot be limited to the type of activities one would find at the foundations and awareness levels of EE. That is, providing learners with an understanding the science concepts and technology which underlie a societal issue is important, but probably will not by itself lead students to action on science and technology-related societal issues. It also follows from the EE literature that it is not sufficient for STS curriculum and instruction to assist learners in the process of exploring and clarifying their attitudes and values toward science and technology-related societal issues (e.g., STS vignettes and class discussions). Neither is it enough merely to emphasize societal issue identification or recount example issue resolution (e.g., case histories/studies).

The clear and direct implication in this EE literature is: if science teachers are to guide learners in the development of the knowledge, skills and affective qualities needed to make decisions and take action on science and technology-related societal issues in a responsible manner, now and in the future, the STS they integrate into science instruction must directly address these capabilities. Learners must expressly be given the opportunity to develop the capabilities to investigate and take action on societal issues through instruction and guided application. This means going beyond the present use of the lecture, audio-visual resources, lab exercises, vignettes, class discussions, case studies, etc.

A Goal Structure and Learner Competencies for STS Education

Given that the "Goals for Curriculum Development in Environmental Education" presented by Hungerford et al. (1980) are based upon a social responsibility model of EE, it appeared to be an appropriate model to guide STS education K-12. Rubba and Wiesenmayer (1985) adapted the Hungerford et al. curriculum structure to STS education leading to the superordinate goal of school STS education, "...to aid citizens in developing the knowledge, skills and affective qualities needed to make responsible decisions on STS [science and technology-related societal] issues, and to take actions on those decisions toward resolution of the issues" (p. 577). The subsequent goal levels are: Level I, the STS Foundations Level; Level II, the STS Issue Awareness Level; Level III, the STS Issue Investigation Level; and Level IV, the STS Action Skills Development Level. Each is discussed below. The parallels with the Hungerford et al. curriculum structure will be obvious to the reader.

STS curriculum and instruction at Level I, the STS Foundations Level, provides learners with sufficient background knowledge, a) of concepts in the natural sciences and social sciences, b) on the nature of science and technology, and c) in the characteristic interactions among science, technology and society, to enable them to make informed decisions on science and technology-related societal issues. Natural science concepts which cut across the respective biological, earth and physical science disciplines, such as, change, field, interaction, model, and system, are candidates for study. Social science concepts from anthropology, economics, psychology and sociology, such as, attitude, behavior, belief, institution, culture, social structure, society, values, are appropriate. At this level learners would develop an understanding of the nature of science and technology, their similarities and differences, and their interdependence, as well as become cognizant of the typical interactions which occur among science, technology and society.

At Level II, the STS Issue Awareness Level, learners become cognizant of how the interrelationships among science, technology and society sometimes result in issues which must be resolved by examining: a) all sides of the issue, b) associated human beliefs and values, c) alternative solutions for resolving the issues, and then by d) taking action. A major thrust at this level is to promote an understanding of the effects of factors, such as, religion, politics, economics and personal interest on the ways STS issues are viewed. Learners would be made aware of the complex of science and technology-related societal issues facing humankind, the impact of those issues, possible alternative solutions, and the need for responsible individual and group actions.

Instruction at Level III, the STS Issue Investigation Level, would develop in learners the knowledge and skills to enable them to investigate science and technology-related societal issues and judge the efficacy of possible solutions against various value positions. STS education directed at Level III has two components. The first encompasses training with problem investigation skills, e.g., problem identification and statement, use of secondary sources, data collection via primary sources (natural and/or social science instruments), data interpretation, drawing conclusions. The second component comprises the opportunity for learners to apply these skills in the investigation of societal issues.

At Level IV, the STS Action Skill Development Level, STS education seeks to develop in learners skills which they could use, working individually or in groups, to take action on science and technology-related societal issues. This, again, includes instructional activities designed to develop an understanding of actions which might be taken from a number of categories (e.g., consumer, legal, persuasion, physical, political), plus opportunities to take actions toward the resolution of societal issues and evaluate the effectiveness of those actions.

Recently, Hickman, Patrick and Bybee (1987) proposed a framework for curriculum reform in STS for secondary school science and social studies. The guidelines in that curriculum framework are arranged under three categories: 1) acquisition of knowledge, 2) utilization of cognitive process skills, and 3) development of values and attitudes. Though organized differently from the Rubba and Wiesenmayer (1985) goal structure, the Hickman et al. curriculum framework is similar in that it is based upon a social responsibility view of STS education. The Hickman et al. curriculum framework, however, places less emphasis upon developing societal issue action capabilities in learners than does the STS goal structure by Rubba and Wiesenmayer.

Learner Competencies in STS

The STS goal structure presented by Rubba and Wiesenmayer (1985) was more fully explicated in a corresponding set of 53 STS learner competencies composed by Rubba (1987b) to guide STS education activities in grades 7 through 12. Learner capabilities and performances are specified for each of the four levels in the STS goal structure. (Those "STS Education Learner Competencies" are presented in Appendix A.)

Wiesenmayer (1988) completed a study which tested the validity of the four STS goal levels (Rubba and Wiesenmayer, 1985), and the accompanying learner competencies (Rubba 1987b), via the integration of a five week STS issue investigation and action unit into multiple class sections of a seventh grade life science course. The theme of the unit, solid waste (trash) management, was an STS issue with which communities in the area of the school district where the study was carried out were attempting to resolve; hence, it had a high level of local relevance. The STS unit was constructed during a two-week summer workshop (lead by Wiesenmayer) by the science teachers who eventually implemented it as the STS treatment in the study. Instructional activities were included in the unit for learner competencies at each of the four STS goal levels.

The findings showed no initial differences across the experimental and control groups on the three dependent variables examined: 1) students' content achievement in STS at each of the four goal levels, 2) number of actions taken by students on STS issues separate from class activities, and 3) students' life science achievement. Statistically significant pre to posttest gains were found among the experimental groups, which completed the STS issue investigation and action unit, on the three dependent variables. The control groups, which received their regular life science instruction, only showed statistically significant gains on life science achievement, as was hypothesized. Experimental to control group posttest comparisons revealed statistically significant differences in favor of the STS groups on STS content achievement and actions taken on sts issues. The gains in life science achievement by the STS group were attributed to the study of issue relevant science concepts within the STS unit.

Implementation of STS in Science Instruction

Rubba (1987c) and Wiesenmayer (1988) both argue that STS issue investigation and action units, similar to the one developed and implemented in Wiesenmayer's research, constitutes a most appropriate, and at present, the only empirically-based model for the integration of STS into school science instruction. They recommend that STS investigation and action units on community relevant STS issues be made a part of science courses over a series of school years, starting at the middle/junior high school level. That recommendation is consistent with our understanding as educators that learners need distributed practice and multiple opportunities, which increase in complexity and extend over time, to develop complex behaviors and attitudes, such as the capabilities and willingness to take action on STS issues.

Additionally, if the science content taught in the science course into which the STS unit is integrated are taken into consideration when the theme of the unit is selected and during its construction, meaningful learning of science concepts can be promoted. In fact, an STS course with a strong science theme might be developed by linking together investigation and action units on STS issues which are linked to selected science concepts. Workshops on teaching STS via issue investigation and action units have been offered by the Penn State University Center for Education in Science, Technology and Society each summer since 1985.

Studies completed by Robinson (1981), Stallings (1982), Wise and Okey (1983), and Yeany and Miller (1983), among others, have enumerated instructional conditions which contribute to student achievement in science. Generally, it has been found that student achievement in science, as measured using paper and pencil assessment procedures, is enhanced when teachers: 1) engage students in a variety of systematically organized learning activities which are tied to well-establish goals and objectives, 2) make students alert to the objective or purpose of instructional activities, 3) assess students frequently on their progress toward meeting the stated objectives, 4) provide immediate feedback to students based upon assessment results, 5) modify instruction in accordance with assessment information, 6) use questioning strategies which include appropriate wait-time to maintain interactive exchange between teacher and students during instruction, and 7) wherever possible, involve students in direct hands-on interaction with materials and methods.

The need to provide for these conditions is as essential in the design and implementation of STS activities which are integrated into science instruction as it is in science education, itself. Still, the STS goal structure discussed above and the STS education learner competencies presented in Appendix A (particularly those at Goal Levels II and IV) designate learner capabilities which go far beyond the knowledge and comprehension emphasis which presently dominate science education K-12 (Harms and Yager, 1981). The goal structure and competencies reflect STS curriculum and instruction which aims to help learners develop a coordinated matrix of knowledge, investigation and thinking skills, and affective characteristics needed to make rationale decisions on STS issues and to implement those decisions through direct action. The educational emphasis should not be as much upon the development of these capabilities as they apply to the resolution of the particular STS issue being studied, as upon the development of a general societal issue attack strategy by which learners/citizens can attempt to resolve and continue to act upon STS issues throughout their lives.

Implications for Inner-City and Minority Students

In an article entitled, "Empowering Minority Students: A Framework for Intervention," Cummins (1986) proposes that the educational failure of minority students is a function of the extent to which schools reflect or counteract the power relations that exist within society. He suggests that when working with minority students educators need to implement instruction that can help liberate them from the "dominated" role which prevail in society at large. Cummins recommends the use of pedagogical approaches which encourage inner-city and minority learners to assume greater control over the setting in which they learn than is allowed in the expository, teacher-centered approaches which are prominent in U.S. classrooms (Goodlad, 1984). "The development of a sense of efficacy and inner directions in the classroom is especially important for students from dominated groups whose experiences so often orient them in the opposite direction" (p.29). Cummins also emphasizes the significant part interactions with the community, especially interactions with parents, plays in the empowerment process;

> Students from dominated communities will be empowered in the school context to the extent that the communities themselves are empowered through their interactions with the school. When educators involve minority parents as partners in their children's education, parents appear to develop as sense of efficacy that communicates itself to children, with positive academic consequences (p.27).

Science instruction which incorporates STS through the use of issue investigation and action units would appear to be consistent with Cummins' (1986) recommendations. Given that STS education research is in its infancy (Rubba, 1987a) and that STS issue investigation and action units have not been studied with inner-city and minority learners, such discussions must be clearly labelled as speculative. Still, as noted above, Ramsey (1987) found a significant difference on individual locus of control after instruction between students who completed an EE issue investigation and action unit and those who had not; those students who completed the STS unit demonstrated increased internal locus of control. We can hypothesize from Ramsey's work that the integration of STS issue investigation and action units into science courses in urban schools similarly would affect the locus of control of inner-city poor and minority students.

There is further reason to propose the use of STS issue investigation and action units with inner-city and minority learners. STS issue investigation and action units of the type implemented by Wiesenmayer (1988) are a students-centered approach in which students are given significant control over the learning situation. For example, units can be structured so students select the particular STS issue(s) to be investigated. In fact, by its very nature issue investigation and action involves students in decisions on the resources to be drawn upon during issue investigation, as well as the actions to be taken. Use of societal issue themes which have local significance as well as significance to urban students in their everyday lives can provide the mechanism by which learner-to-family and learner-to-community linkages are facilitated within the issue investigation and action process. Local STS issues which urban students can impact directly as individuals, with their parents, or in family, peer or community groups, within a relatively short period of time (e.g., energy consumption, trash-ridden lots, abandoned cars) might be used in the STS units to which urban students are first exposed. Issues associated with other urban relevant STS areas, such as, health and medicine, land use/development, product safety/liability, and transportation, might be used later once learners' efficacy perceptions have risen to a level where more entailed issues can be tackled.

In addition, in the hands of culturally sensitive teachers STS issue investigation and action units would appear to have a very high probability of helping urban youth overcome the sense of irrelevance many inner-city poor and minority students associate with schooling by providing real-world science experiences. The sense of control which urban learners would develop out of investigating and taking action on STS issue would surely have a positive influence on their self-esteem. Both of these affective attributes have been associated with school drop out by minority students (Raywid, 1987; Williams, 1987). Also, it may be that the integration of STS issue investigation and action units into middle school science would enhanced concept understanding among urban students (NAEP, 1987) and/or lead to a more positive attitude toward science. Again, such discussions are speculative and need to be carefully examined in well-designed studies.

Synopsis

The integration of STS issue investigation and action-based units into science instruction, as described in this paper, holds the potential for enabling our citizens to deal in a responsible and direct manner with the science and technology-related societal issues which threaten humankind. For inner-city poor and minority learners, it may be, in addition, the type of "quality," "regular" instruction called for by the National Alliance of Black School Educators (1984) which will empower them to fully participate in American society.

APPENDIX A

STS Education Learner Competencies
(Rubba, 1987b)

1. STS Foundational Competencies

At this level the student will be able to...

a. state a definition of science which characterizes it as an empirical inquiry process.
b. describe the nature of scientific laws, theories, concepts, or "factual" statements.
c. classify scientific explanations as: laws, theories, concepts, or "factual" statements.
d. apply basic natural science laws, theories and concepts in problem solving situations.
e. apply basic social science laws, theories and concepts from anthropology, economics, psychology and sociology as these impinge upon STS issues.
f. define technology in terms of a socio-technical system of use.
g. identify examples of technological development.
h. distinguish between examples of science and technology.
i. describe the characteristic interrelationships which exist among science, technology and society.
j. name examples of the interaction between science and technology, and describe the nature of the interaction.
k. name examples of the interaction between science and society, and describe the nature of the interaction.
l. name examples of the interactions between technology and society, and describe the nature of the interaction.

2. STS Issue Awareness Competencies

The student will be able to...

a. state a definition of an STS issue.
b. distinguish between examples and non-examples of STS issues.
c. name current STS issues which have significance at the local, national and/or global level(s), and describe why the issues are significant.
d. assign priority to STS issues in terms of their local, national and/or global significance, and justify the assigned priority.
e. identify the various value positions associated with an STS issue, and characterize those positions.

f. identify and describe the system of scientific and social beliefs which found the respective value positions associated with an STS issue.
g. identify the natural science laws, theories and/or concepts which impinge upon an STS issue.
h. identify the social science laws, theories and/or concepts which impinge upon an STS issue.
i. identify the technological development(s) which impinge upon an STS issue.
j. describe the complex of science, technology and social interactions which characterize an STS issue and attempts to resolve the issue.
k. express the belief that responsible individual and/or group action(s) is necessary if an STS issue is to be resolved.
l. explain why there exists a variety of possible courses of action which might be taken on an STS issue.
m. predict STS issues which could arise in the near future as a result of the interactions among cutting-edge science and/or technology, and society.

3. STS Issue Investigation Skill Competencies

The student, at this level, will be able to...

a. construct well-formed statements of STS issues.
b. use secondary sources to investigate STS issues.
c. use primary natural science data collection procedures to investigate STS issues.
d. use primary social science data collection techniques to investigate STS issues.
e. design and conduct a study to investigate an STS issue.
f. interpret data collected in the investigation of an STS issue.
g. draw conclusions from data collected in the investigation of an STS issue.
h. make inferences from data collected in the investigation of an STS issue.
i. predict consequences from the findings of an STS issue investigation.
j. make recommendations for the future course(s) of action on an STS issue based upon the findings of an investigation.
k. communicate the results of an STS issue investigation via an oral report.
l. communicate the results of an STS issue investigation via a written report.
m. make a meaningful contribution to a group investigation of an STS issue.
n. conduct an individual investigation of an STS issue.

4. STS Issue Action Skill Competencies

At this fourth level, the student will be able to...

a. identify examples of civil, consumer, legal, persuasion, physical, and political actions taken on STS issues.
b. classify examples of actions taken on STS issues as: civil, consumer, legal, persuasion, physical, and political actions.
c. identify alternative ends toward which an STS issue might be resolved.
d. identify the consequences associated with the resolution of an STS issue toward a particular end.
e. assign priority to the various ends toward which an STS issue might be resolved, and justify the assigned priority.
f. identify alternative action plans by which an STS issue might be resolved.
g. identify the consequences associated with using a particular action plan toward the resolution of an STS issue.
h. assign priority to the various action plans by which an STS issue might be resolved.
i. make a personal commitment to an STS issue(s) which needs to be resolved.
j. implement action plans as part of a group toward the resolution of local, national, or global STS issues.
k. implement action plans on an individual basis toward the resolution of local, national, or global STS issues.
l. assess the effectiveness of actions taken toward the resolution of an STS issue.
m. modify an STS issue action plan based upon an assessment of its effectiveness.

References

Aaronian, R. and Brinckerhoff, R. (1980). The Exeter conference on secondary school science education. Phillips Exeter Academy, Exeter, NH.

Brinckerhoff, R. F. (1985a). A new technique for teaching societal issues. Journal of College Science Teaching. May, 475-479.

Brinckerhoff, R. F. (1985b). New technique for teaching societal issues in school science courses: abridged version. S-STS Reporter, Summer, 4-6.

Brinckerhoff, R. F.. (1985c). An experimental method for infusing STS into secondary school curricula. Bulletin of Science, Technology and Society. 5, 130-137.

Brinckerhoff, R. F., (1986). Values in school science: some practical materials and suggestions (2nd ed.). Phillips Exeter Academy, Exeter, NH.

Bybee, R. and Bonnstetter, R. (1987). What research says: implementing the science-technology-society theme in science education: perceptions of science teachers. School Science and Mathematics, 87 (2), 144-152.

Cummins, J. (1986). Empowering minority students: a framework for intervention. Harvard Education Review, 56, 18-36.

Disinger, J. (1986). Locating the "E" in S/T/S. ERIC Information Bulletin, (3), - .

Goodlad, J. (1984). A Place Called School: Prospects for the Future. McGraw-Hill: New York.

Harms, N. and Yager, R. (1981). What research says to the science teacher, Volume III. Washington, DC: NSTA.

Hickman, F., Patrick, J. and Bybee, R. (1987). Science/technology/society: A framework for curriculum reform in secondary school science and social studies. Social Science Education Consortium, Inc., Boulder, CO.

Hines, J., H.R. Hungerford, and A. N. Tomera. (1987). "Analysis and Synthesis of Research on Responsible Environmental Behavior: A Meta-Analysis." Journal of Environmental Education, 18(2), 1-8.

Hofwolt, C. (1984). "Instructional Strategies in the Science Classroom." In D. Holdzkom and P. Lutz (Eds.). Research Within Reach: Science Education, pp. 43-57. NSTA: Washington, DC.

Hungerford, H., Peyton, R., and Wilke, R. (1980). Goals for curriculum development in environmental education. The Journal of Environmental Education, 11 (3), 42-47.

Klingler, G. (1980). The effect of an instructional sequence on the environmental action skills of a sample of Southern Illinois eighth graders. Unpublished master's research report, Southern Illinois University at Carbondale.

National Alliance of Black Educators. Saving the African American Child. Task Force on Black Academic and Cultural Excellence.

NAEP. (1978). Science achievement in the schools. National Assessment of Educational Progress, Education Commission of the States. Denver, CO. December.

National Science Board. (1985). Science indicators, the 1985 report. U.S. Government Printing Office, Washington, DC.

National Science Board. (1983). Commission on Precollege Education in Mathematics, Science and Technology. Educating Americans for the 21st Century. U.S. Government Printing Office, Washington, DC.

National Science Teachers Association. (1982). Science-technology-society: science education for the 1980s. NSTA, Washington, DC. (NSB 85-1)

Ramsey, J. (1987). A study of the effects of issue investigation and action training on characteristics associated with environmental behavior in seventh grade students. Unpublished doctoral dissertation, Southern Illinois University at Carbondale, IL.

Ramsey, J., Hungerford, H. and Tomera, A. (1981). The effects of environmental action and environmental case study instruction on the overt environmental behavior of eighth grade students. The Journal of Environmental Education, 13 (1), 24-29.

Raywid, M. (1987). Making school work for the new majority. Journal of Negro Education, 56, 221-228.

Robinson, J. (1981). Research in Science Education: new questions, new directions. ERIC Clearinghouse for Science, Mathematics and Environmental Education, Columbus, Ohio, ED 209 075.

Rubba, P. (1986, March). An investigation of the semantic meaning assigned to concepts affiliated with STS education and of STS instructional practices among a sample of exemplary science teachers. A paper presented at the 1986 Meeting of the National Association for Research in Science Teaching, San Francisco, CA.

Rubba, P. (1987, February). The current state of research in precollege STS education: a position paper. A paper presented at the Second National Technological Literacy Conference, Washington, DC. (a)

Rubba, P. (1987). Recommended competencies for STS education in grades 7-12. The High School Journal, 70 (3), 145-150. (b)

Rubba, P. (1987). An STS perspective on environmental education in the school curriculum. In J. F. Disinger (Ed.). Trends and Issues in Environmental Education: EE in School Curricula (pp. 63-71). ERIC Clearinghouse for Science Mathematics, and Environmental Education. (c).

Rubba, P. (1988, April). The effects of infusing STS vignettes into the genetics unit of biology or learner outcomes in STS and genetics: a report of two investigations. A paper presented at the 1988 Annual Meeting of the National Association for Research in Science Teaching, Lake Ozark, MO.

Rubba, P. and Wambaugh, R. (1987, March). Changes in biology teachers' STS instructional activities. A presentation at the 1987 Meeting of the National Science Teachers Association, Washington, DC.

Rubba, P. and Wiesenmayer, R. (1985). A goal structure for precollege STS education: a proposal based upon recent literature in environmental education. Bulletin of Science, Technology and Society, 5 (6), 573-580.

Rubba, P. and Wiesenmayer, R. (1987 April). Goals and competencies for precollege STS education: recommendations based upon recent literature in environmental education. A paper presented at the annual meeting of the National Association for Research in Science Teaching, Washington, DC. (In press (1988). Journal of Environmental Education, 19(4)).

Sia, A., Hungerford, H. and Tomera, A. (1986). Selected predictors of responsible environmental behavior: an analysis. Journal of Environmental Education, 17 (2), 31-40.

Stallings, J. (1982). Applications of classroom research of the 1970s to mathematics and science instruction. In What research says to the science teacher. volume 4. R. Yager (ed). NSTA, Washington, DC, Chapter 2.

Volk, T. (1984). Project synthesis and environmental education. Science Education, 68 (1), 23-33.

Waks, L. (Ed). (1986). Technological literacy: proceedings of the first national conference. Bulletin of Science, Technology and Society, 6 (2 & 3).

Waks, L. (Ed). (1987). Technological literacy: proceedings of the second national conference. Bulletin of Science, Technology and Society, 7 (1 & 2).

Waks, L. and Prakash, M. (1985). STS education and its three step-sisters. Bulletin of Science, Technology and Society, 5(2), 105-116.

Wiesenmayer, R. (1988). The effects of three levels of STS instruction and traditional life science instruction on the overt citizenship behavior of seventh grade students. Unpublished doctoral dissertation. The Pennsylvania State University, University Park, PA.

Williams, S. (1987). A comparative study of black dropouts and black urban high school graduates in an urban public school system. Education in Urban Society, 19(3), 311-319.

Wise, K. and Okey, J. (1983). A meta-analysis of instructional systems applied in science teaching. Journal of Research in Science Teaching. 20(5), 419-435.

Yeany, R. and Miller, A. (1983). Effects of diagnostic/remedial instruction on science learning: a meta-analysis." Journal of Research in Science Teaching. 20(1), 19-25.

READING ISSUES IN SECONDARY SCIENCE AND STS FOR URBAN AND MINORITY LEARNERS

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I. INTRODUCTION

Reading issues intersect with the teaching of Science and STS materials in several specific ways. Fundamental to reading, as to STS learning, is the concept of metacognition. The term metacognition, as it applies to reading, refers to "the knowledge learners have about reading strategies and the ability to capitalize upon such knowledge to monitor their own reading" (Vacca and Vacca 1986, 254; and Tierney 1982). A metacognitive approach to reading instruction implies a self-aware and active role for the learner as a generator of knowledge. Students' prior knowledge, their attitudes toward reading, and their ability to synthesize or integrate new learning with prior knowledge are as important in reading as in science/STS instruction. In this review of the important and recent literature, we focus on these issues. Our primary concern will be student comprehension of the material selected by the student or teacher for reading. A second concern is the use of reading materials for concept development in the context of the Science/STS curriculum. A third concern is the analysis of materials for problems of text difficulty and readability, patterns of text development, and suitability of the text for urban or minority students.

We proceed from a theoretical discussion of these issues through discussions of specific teaching strategies that may be suitable in urban classrooms. Because this is an overview, we include only a few details of each strategy. References are to easily available materials. Teachers are encouraged to check those sources for additional information.

II. METACOGNITION AND INDEPENDENT READING

Reading in Science and STS is characterized by the discovery of meaning and knowledge through the study of written material. Reading instruction in science means "to teach simultaneously the science content and the reading and reasoning process by which that content is learned" (Thelen, 1984, foreword).

A reader makes sense of texts by using both background knowledge and expectations about and interactions with written language. This interaction between reader and text is a process largely controlled by the reader. It is the teacher's role to facilitate this interaction. Reading should not be considered as a set of separate skills, but as a process by which students, acquire information, think about what they read, and use what they have read.

The ability to read independently is especially important in the secondary years, since very little class time is devoted specifically to reading and texts are still the basic sources of information (Alvermann, Conley, and Moore, 1986). In independent reading readers control their own learning. The teacher provides support and guides progress towards independent learning by asking questions, giving demonstrations, providing guide materials and prereading strategies, and so on. The teacher's task is to show the students not what to learn but how to learn, how to investigate and interpret a text effectively. This independent reading will enable students to read independently as required in STS at the issue investigation. The search for background information and the synthesis of that information with data developed by independent investigation will allow students to develop STS action plans (Rubba, 1988).

To achieve independent learning, students must make a gradual transition from teacher-centered guidance to self-control and self-monitoring of their own reading and studying. Prerequisites for independent learning are knowledge and awareness of the reading process.

A student who is able to monitor his or her own reading approaches a text assignment by 1) analyzing the task, reflecting upon what he or she does and doesn't know about the material; 2) making plans for reading: 3) using strategies suited to his or her purpose for studying, the particular text. Such students recognize whether they have problems with a particular text selection and why. By using appropriate reading and study strategies, they can solve such problems. Studies suggest that most secondary school students either don't possess such self-monitoring strategies or don't apply them (Tierney 1982).

Vacca and Vacca (1986) describe an instructional strategy that helps students develop metacognitive skills for reading, based on extended experience with content area text, process explanations, and modeling.

This framework consists of four components:

1) Assessment: the teacher determines the level of knowledge students have about a particular study

strategy. The students are asked to apply a study strategy to a text selection. the teacher observes the use of the strategy and asks the students key questions about the way they used it.

2) Awareness: based on the assessment, the teacher interacts with the students which clarify why and how to use the study strategy.

3) Modeling and demonstration: in demonstration sessions, the teacher models, explains, reinforces the rules or procedures, and gives the students practice in using the strategy. The goal of this procedure is reached when the students feel in control of the strategy, and can use it selectively and flexibly.

4) Application: students are given text assignments that are formulated in such a way that students have to apply certain study strategies.

Research suggests that students' comprehension increases after a teacher's instructional intervention aimed at developing their self-monitoring strategies (see also Brown and Palinscar [1982], for a more extensive description of this instructional framework).

III. CHARACTERISTICS OF TEXTS

A. TEXT STRUCTURE

Although comprehension of texts is strongly influenced by the students' prior knowledge and experience, texts nevertheless have a particular structure separate from the student's cognitive structure. It is especially important to examine characteristics of texts since written materials occupy a dominant place in science and STS instruction. Textbooks in particular play a central organizing role in science instruction, although STS encourages the selection of other written materials to supplement text books, e.g. current newspaper and magazine articles.

Thelen (1984) remarks that science teachers often complain that their students cannot read the textbook and don't learn from it. This does not mean that the use of textbooks should be abandoned. Instead, it should be recognized that textbooks are important means for increasing knowledge and understanding, gaining new insights, and sharing the experiences and feelings of others (Vacca and Vacca 1986). Sometimes the reading problem stems from a mismatch between the students' reading abilities and the readability level of a text. Reading problems at the secondary level are usually not related to deciphering the text but to understanding its message (Alvermann, Conley, and Moore 1986).

Little effective independent learning arises from most secondary content texts, according to Tierney (1982). However, since most science instruction in class is based on oral presentations and most of the reading is done outside of class, the ability to read independently is of utmost importance for the student (Alvermann, Conley, and Moore 1986). Students must be able to analyze texts in order to understand their potential use as effective tools in an independent learning strategy. The text being used might contribute to the students' development of self-monitoring abilities. Making judgments about a text depends also upon its intended function. For example, is it the primary source of information? Is it supplementary or used as a reference? Is it a source of uncontested facts and concepts, or is it a statement of one among several possible positions?

The structure of a text refers to a "hierarchical arrangement of sentences and paragraphs within a large piece of text" (Alvermann, Conley, and Moore 1986, p. 64). Authors impose a structure on their presentation of ideas. Students' ability to recognize the different types of structures used in science texts and other reading materials is the key to comprehending and retaining the ideas (Niles 1964; Meyer and Rice 1984; and Vacca and Vacca 1986).

External structural features of texts are important cues for comprehending their overall design. The reader should first examine the preface, the table of contents, the bibliography, and such. Within each chapter, the reader should look at the introduction, the headings, the graphs, and the summary as indicators of the structure of a text.

The internal organization of a text refers to the interrelationships among important and less important ideas. Science textbooks can be classified as expository texts, since the primary form of discourse is the presentation of information. Different patterns of logical connections exist among the ideas. In top-level structure the superordinate (most important) ideas all located at the "top level" of the presentation, with the many supporting ideas below them (Meyers 1975).

Herber (1978) distinguishes among four organizational patterns (or top-level structures) found in expository texts.

1) enumeration: information is simply listed. The author does not indicate logical connections among sentences, facts, characteristics, etc. This pattern is found most frequently in textbooks (Vacca and Vacca 1986). Words

that signal this pattern are to begin with . . . first . . .,second . . . ; . . . follow:

2) time order: a sequential relationship exists among the ideas, indicated by signal words, such as on (date), not long after, now, and when.

3) comparison-contrast: the likeness or differences among facts, people, events, or concepts, are presented. Signal words for this organization pattern are however, but, on the other hand, but also, similarly.

4) cause-effect: the author indicates how facts, events, or concepts (effects) happen or came into being as a reaction to other facts, events, or concepts (causes). Signal words include because, since, nevertheless, accordingly, and if . . . then.

Vacca and Vacca (1986) add problem-solution as a fifth top-level structure. A problem is developed and followed by its solution(s); this is a special case of the cause-effect pattern. These five patterns can be combined in a complex way (for a more complete description and examples, see Herber [1978], Meyer [1975], and Vacca and Vacca [1986]). Knowing the structure of texts helps the student to follow the authors' thoughts, to discover meaningful relationships among important and less important ideas, and to retain what they have read (Alvermann, Conley, and Moore 1986). Such knowledge is especially useful in working at the Issue Awareness Level 2 on the STS Goal Hierarchy (Rubba, 1988). The student's need to deal with multiple points of new will require comparing and contrasting ideas, positions, proposals for action.

A somewhat different approach to text structure is emphasized by Estes (1982). According to him, the important question is not "whether students can see the structure in texts, but whether they can realize structures for texts." Texts that lend themselves to "realization" by readers are more susceptible to comprehension. His research on the perceived structure of texts reveals that the best predictor of reader recall is his or her prior familiarity with the ideas; there is only a moderate relationship between the idea's importance and the likelihood of its recall. He also found that important ideas are very often stated in a dense form, while some important principles are not explicitly stated. Examples are sometimes inconsistent with the principle they are supposed to illustrate.

Alvermann, Conley, and Moore (1986) describe four criteria by which one can asses the degree of "considerateness" of a text. A considerate text makes learning from written material easier.

The four criteria are

1) structure: a plan for how ideas are arranged and connected;

2) coherence: clarity of relationships among ideas, within and across sentences and paragraphs;

3) audience appropriateness: a good match between readers' knowledge and what the text is teaching;

4) unity: the degree to which only relevant information is included to support the author's assumed purpose.

Alvermann, Conley, and Moore signal a gap in reading regarding unity. The argument for the importance of unity is mainly theoretical: that information in disunified text may lead to the readers short-term memory being overloaded, preventing the reader from integrating the new information with existing knowledge (see also Estes [1982]). Research done by Anderson, Armbruster, and Kanter (1980) reveals that texts often contain misleading titles, don't clarify main ideas, omit crucial information while presenting contradictory information, and are ambiguous. Both Estes (1982) and Wetmore (1980) provide guidelines for rewriting textbooks with the purpose of improving comprehension (in Alvermann, Conley, and Moore 1986).

B. READABILITY AND DIFFICULTY

To evaluate a text one must assess its readability level. Readability refers to "the ease of understanding of a text chiefly because of features of writing style" (Alvermann, et al., 1986, 47). Although the students' interests, background knowledge, and motivation have an important effect on their success in learning from a text, a prerequisite is a level of difficulty that is appropriate to their abilities.

Vacca and Vacca (1986) make a distinction between a qualitative ("professional judgment") and a quantitative analysis of the readability level of a text. They present an adaptation of the Irwin and Davis Readability Checklist (1980), which focuses on the understandability, usability, and interestability of texts (p. 41, ff). Understandability refers to the potential match between what a particular group of readers knows and the presented information. Usability relates to the way the content is presented and organized. Important issues here are coherence, unity, and structure (see also Alvermann, Conley, and Moore, [1986]). The interestability of a text refers to whether the features of a text appeal to a given group of students.

Understandability and interestability are particularly important criteria for minority students, who may have experiences and knowledge that are culturally different from the majority. For example, textbooks usually don't have illustrations and pictures that show people similar to themselves.

The use of formulas for assessing readability of textbooks has received a lot of attention. More than 30 formulas exist, according to Vacca and Vacca (1986). Attempts to improve comprehension by matching readability scores of a text with the student's reading ability are limited. The formulas don't deal with the prior knowledge and experiences of the students (for example, emotional, cognitive, and linguistic backgrounds). In addition, such formulas are usually based on sentence length and the complexity of words, while long sentences, rated as more difficult, may provide clues for their interpretation that make them easy to understand. Also, students exhibit a wide range of reading ability, a range which increases every school year (Alvermann, Conley, and Moore, 1986). However, for the teacher who is aware of their limitations, a readability formula may provide a useful rule of thumb.

Widely used readability formulas are 1) Fry's Readability Graph, 2) Raygor Readability Estimate and 3) the Simple Measure of Gobbledygook (SMOG).

1) Based on the length of sentences and the number of syllables words, the Fry Graph provides an estimate of the difficulty of reading passages. The levels of difficulty can be matched with appropriate grade levels from first grade through college.

2) The Raygor Readability Estimate is similar to Fry's, except that word difficulty is measured by counting the letters in long words (six letters or more is rated difficult) rather than the syllables.

3) The SMOG formula yields a grade level score, indicating the reading grade a reader must have achieved in order to understand the text fully. The SMOG score is also (indirectly) based on sentence length and word difficulty, but does not involve the use of a graph. (For a more detailed overview of these and other readability formulas, see, Vacca and Vacca [1986]; Alvermann, Conley, and Moore [1986]; or Klare [1974]).

Some alternative procedures rate the difficulty of textbooks on the bases of the actual reading performance of students. Cloze procedures involve the systematic deletion of words from text passages. The reader's ability to fill in the words that are deleted provides an estimate of text difficulty. A score below 40 percent correct completions indicates that the text is probably too difficult for the reader (frustration level). A score between 40 - 60 percent indicates that the student can read the material with some guidance. Reading at the independent level is indicated by a score of more than 60 percent. For a teacher to assign reading outside class time, the textbook selected should be at the independent level (Alvermann, Conley, and Moore, 1986; Thelen, 1982; Vacca and Vacca, 1986). Several variations of the Cloze Procedure exist, such as the maze technique and the Bormuth Mean Cloze Readability test (Alvermann, Conley, and Moore 1986; Vacca and Vacca 1986). (See Estes [1982] for alternative readability assessments).

IV. MINORITY ISSUES AND LANGUAGE DIFFERENCES

A. INCLUSIONS OF MINORITY ISSUES/PEOPLE

Although many articles discuss nonstandard dialect, most deal with teaching English in elementary schools. We will discuss the research on the potential interference of nonstandard (black) dialect with comprehension in Section B. In this section, we present some implications of theory and research findings that may explain some of the particular problems minority students (mostly referring to black students) may encounter in studying science texts.

Olson states that textbooks are "a particular mode of communication which determines a view of reality" (in Estes, 1982, p. 86). In addition, texts are written for a preconceived audience. Minority students may not be considered explicitly as an important and distinct part of this audience. In addition, the author's view of reality may not be readily recognizable for many inner-city minority students. Conversely, the students' views of reality may not be reflected in any assigned or recommended reading materials in science class. Throughout the literature on reading in science, writers stress that background knowledge, experience, and attitudes are significant factors in reading comprehension. What are often perceived as black students' reading failures may be more deeply rooted in their views of reality and perceptions of themselves from cultural and historical perspectives (Chaplin 1985). When new information does not conform to existing perceptions, it may be reconstructed or rejected.

Blacks have often perceived that they are considered inferior with respect to their experiences, language, and socio-economic status. Unfortunately, reading often represents an activity in which foreign ideas are imposed upon their intellects and wills. Appropriate secondary science textbooks and curriculum materials, based upon situations, events, and persons with which minority students can identify, may be hard to get. Teachers have the task of bridging the gap between text and experience.

As things now stand, school experiences often promote for minority students a negative perception of themselves in general and of their reading abilities in particular. This suggests that teachers need to adopt strategies which assist students in building confidence in their abilities and to recognize the students' internal capacities, separate from their current behavior performance or scores on standardized tests.

A feeling of power to control the text is essential for comprehension. Trout and Crawley (1985) report research findings on students who feel they have little control over their fates. The instructional strategy that develops a more positive student attitude in science includes frequent teacher-student interaction, a high rate of arbitrary instead of task-dependent reinforcement, and a fixed structure within the learning situation. Knowledge and awareness of the reading process and the ability to regulate their own reading are crucial for minority students. The idea of metacognition, as explained in the first part of this paper, and the teaching and study strategies based on this idea (Section VI) are highly applicable to science reading for minorities.

B. PROBLEMS OF LANGUAGE DIFFERENCES

Any dialect or variety of a particular language is a product of culture, environment, the needs of the group, and contact with other languages (Alexander, 1985). Although Black English differs from 'media' English in some phonological, syntactic, and lexical features, research suggests that these differences do not interfere with reading comprehension, except that they create some confusion in beginning reading programs (Weaver and Shonkoff 1978). Weaver and Shonkoff ascribe the perceived reading problems to the attitudes of teachers who come from a cultural and socio-economic background different from that of their minority students. They state that teachers' attitudes and expectations have a negative impact on students' motivation and performance, which may interfere with reading. Rather than diagnosing black students as disabled, teachers must display a positive approach to teaching black students. They must convey to their students that a dialect is not an inferior form of language and must recognize that dialect per se is unlikely to interfere with reading. In addition, teachers must know the features of the nonstandard dialect so that "errors" are not interpreted as reading or comprehension problems.

The authors of essays in Tapping Potential: English and Language Arts for the Black Learner (Brooks 1986) convey clearly that the basic issue regarding the reading problems of black students lies in the misunderstanding of language differences. Respect for individual differences is essential, because "to deny the student's language is to deny the student" (Perry, in Brooks, 1986).

Turner (1986) does away with several myths about black English, such as these:

1. There is one black English. (In fact, Blacks speak many varieties of black English.)

2. Dialects lack the vocabulary for precise thinking and understanding.

3. Black students hear in black English, so they spell in black English. (If this were the case, Bostonians, for example, would write "Baston." Also, English is not a phonetic language: compare, for example, the spelling of proceed, precede and supersede. Turner's conclusion is that no single approach is suitable for teaching all black children. He admits that he is not able to resolve the question of whether to teach standard English or whether to urge bidialecticalism.)

Finch (1986) provides practical tips for teachers who work with learners who speak several dialects. Communications between student and teacher and among students can be fostered when teachers are willing to understand different dialects and to show respect for differences. The teacher's ultimate goal is for students to achieve proficiency in the use of standard English.

Lack of motivation is considered by many educators to be the main reason inner city childrens' problems in learning and reading. Cureton (1986) acknowledges the importance of motivation for learning, but he stresses the importance of discovering each individual's learning style. Learning style refers to the most comfortable manner of learning, (for example, visual or auditory, independent or group). If the teacher uses an individual's strengths, he or she may be able to raise the student's motivation. Cureton refers to research on cognitive style mapping, which shows that inner-city children learn more effectively when physical and oral involvement are present.

V. COMPREHENSION AND STRATEGIES

A. IMPORTANCE OF PRIOR KNOWLEDGE TO READING COMPREHENSION

Background knowledge

As has been stressed before, students' prior knowledge and attitudes have a great impact on their comprehension of the text. Recently, researchers have paid increasing attention to background knowledge, partially because of the popularity of a "schema" approach to reading (Vacca and Vacca 1986). A schema "is used to represent information that is stored in an organized way in your memory and that is based on your repeated encounters with a particular person, place, thing, or event in the past" (Alvermann, Conley, and Moore 1986, p. 70). Several schema inadequacies can interfere with reading comprehension.

1. Schema unavailability refers to a lack of relevant background knowledge and information needed for understanding a text assignment.
2. Schema selection refers to the case where sufficient background knowledge is available but the student is not able to activate it.
3. Schema maintenance means that "students may not be aware or skilled enough at recognizing when shifts in schema occur during reading."

A related problem is that students may have their own "theories" about scientific phenomena which interfere with a meaningful understanding of the science concepts presented in textbooks. These naive theories have been developed over the years from the student's everyday experiences (Vacca and Vacca 1986).

Assessment of schema qualities helps the teacher to make decisions about, for example, the amount of prereading preparation students will need and how much background building will be necessary. One strategy involves constructing a background knowledge inventory according to the major ideas and concepts to be studied. The outcome of this inventory should be discussed with the students to introduce them to the major concepts they will need. (Vacca and Vacca 1986; Alvermann, Conley, and Moore 1986)

A more formal procedure is the PreP (Prereading) Plan, which encourages group discussion and an awareness of the topics to be covered (Langer 1981). The teacher determines the key words, phrases, or pictures in the text, that represent the major concepts. In three phases, he or she introduce the topic to groups of ten students:

1) discover the students' initial associations with the concept;

2) students to reflect on their initial associations;

3) reformulate their knowledge based on the discussion;

By observating and listening, teachers can clarify their students' background knowledge and focus their instruction accordingly (for a more detailed description, see Vacca and Vacca [1986]). Through such assessment strategies, students' prior knowledge that conflicts or is culturally different from the text may become apparent. The prereading strategies discussed later can also be used for assessing students background knowledge.

Reading attitudes

In 1979-1980, the National Assessment of Educational Progress made reading assessments of more than 100,000 students from both elementary and secondary schools (Vacca and Vacca 1986). Disappointing results regarding the attitude component of reading were paramount. For example, about half of the 17-year olds considered reading as their least favorite leisure-time activity. About 10 percent of the students did not read at all, and the older students got, the less they liked reading.

Lewis and Teale (1980) state that reading attitude consists of a cognitive component (beliefs or opinions about reading), an affective component (feelings about reading), and a behavioral component (intentions to read and actual reading behavior). Students' interests and their perceived degree of control over a reading task are important factors in determining their reading attitude.

Assessing reading attitudes can be done through informal observation and through attitude scales. In informal observations of a class or in observations of individual teachers can take notes or use a checklist to collect data about attitude-related behavior, for example, willingness to receive instruction, library habits, and amount and kind of free reading. The Rhody Secondary Attitude Assessment is a valid and reliable reading attitude scale. The scale includes measures of school-related reading, library reading, recreational and general reading (for more details and references, see Vacca and Vacca [1986]). The Estes Reading Attitude Scales provide measures of attitudes toward reading in specific subject areas, including our scale for reading in science (Estes, 1971).

B. INSTRUCTIONAL STRATEGIES

Once the teacher has assessed background knowledge and attitudes, he or she can select instructional strategies and adapt their for particular subjects, schools, and classrooms.

Prereading strategies

Prereading preparation is an often neglected area of science teaching (Thelen 1984; Vacca and Vacca 1986; Vaughan 1982). When students study new material without having background knowledge, they tend to memorize. Thelen (1984) argues that students have often learned through experience that memorization leads to correct answers. In addition, certain teachers tend to encourage rote memorization by giving little credit to substantially correct answers that do not correspond verbatim to the text. Rote learning is also an alternative for students whose anxiety level is high or who lack confidence in their ability to learn meaningfully.

Prereading instruction can be connected with two principles: the feed-forward effect and cognitive readiness. 'Feed-forward' refers to the reader's anticipation of what will be learned through written materials (Stauffer 1975). The questions "What do I need to know?" and "How well do I already know it?" help readers to reflect on their knowledge, to make predictions, and to set goals. The ability to ask these questions and to reflect upon them requires metacognitive awareness. Cognitive readiness refers to "the ability of a learner at a given age to cope adequately with the demands of a given task." (Ausubel, et al. (1978) in Vacca and Vacca, 1986, p. 101). The most important function of the strategies discussed here is to prepare students to be confident and to think positively about what they will encounter in text assignments.

Building and Activating Background Knowledge

Several strategies exist to help students organize what they already know and to show them where and how new ideas fit into the knowledge they already have. Some of these strategies will be discussed here. For more detailed descriptions of these and other strategies, see Herber (1978), Thelen (1984), and Vacca and Vacca (1986).

Existing material:

- Use multiple textbooks. The rationale for using several reading sources is to accommodate students of different reading abilities and to provide materials of varying levels of readability.

- The use of popular books, pamphlets, and magazine selections. This strategy shows the power of the reading process in helping students to generate their own background knowledge and to build multiple perspectives.

Teacher-made materials:

- Advance organizers. Ausubel (1968) defines advance organizers as "preparatory paragraphs which . . . enhance the discriminability of the new learning material from previously learned ideas" (Vacca and Vacca 1986, p. 107). Advance organizers must be formulated in terms already familiar to the student. Their main purpose is to make written materials more predictable by providing a frame of reference so that readers can link new material with what they already know. Organizers in different formats have been developed: as introductory paragraphs, as graphic displays, and as part of verbal presentations.

  Studies of the effectiveness of the use of advance organizers in the classroom have produced mixed results. Lott (1983) performed a meta-analysis regarding the use of advance organizers and found that advance organizers have been more advantageous in urban than in rural or suburban settings, while the style of organizer and the characteristics of the material had little effect. Vacca and Vacca (1986) argue that the effectiveness of an advance organizer depends on how well the organizer is constructed and how actively students are involved in discussing it prior to ready the text.

  They make the following recommendations:

  1) construct organizers only for difficult material;
  2) construct them in such a way that they reflect the main ideas in the assigned text;
  3) use real-life incidents, examples, anecdotes or illustrations to which the students can relate;
  4) use analogies to activate background knowledge;
  5) ask questions in organizers to arouse curiosity and interest.

- Structured overview (Barron [1969] 1968; and Thelen 1984). A structured overview is a graphic device that displays the concept vocabulary to help students anticipate concepts and their hierarchical relationships. For examples and construction guidelines, see Vacca and Vacca (1986) and Thelen (1984).

- Frayer model. The Frayer model is a modification of a structured overview and is meant to help students apply the learned concepts to new situations. The teacher extends the clarification of concepts by providing the students with examples and non-examples as well as the essential and non-essential characteristics of the new concepts (Thelen 1984).

Student-made materials:

- Student structured organizers. Thelen (1984) considers student-structured organizers to be more effective than teacher-made organizers. Although they seem more appropriate as a part of a post-reading strategy, they can be used to organize the students' knowledge prior to reading. Examples of student constructed overviews are concept maps and Vee maps.

  One approach to the construction of a concept map is to provide the students with a list of related concepts. The student's task is to decide how to represent the concepts hierarchically and which words to use to link the concepts together. The Vee map requires the students to identify the main question and the events or objects used to answer the question. Other elements that have to be identified include the theories used, principles and conceptual systems, and knowledge claims. Although the construction of Vee maps generates much useful class discussion, they are difficult tools for students to understand and apply. Lehman, Carter, and Butler (1985) investigated the effectiveness of concept mapping and Vee mapping in helping black, inner-city, high school students learn biology concepts in a meaningful way. Although no evidence was found for increased effectiveness, the experimental group (using the mapping devices) showed a higher degree of meaningful learning than did the control group.

  A combination of teacher-constructed maps and student-constructed maps may be useful. Semantic or concept mapping can begin with a teacher-constructed skeleton map as a prereading strategy. Students work to complete and amplify the map in prereading discussion, as part of the reading task, and in postreading and closure activities. To build a map, four components are distinguished:

  1) a core concept or question to which all the other ideas are related;

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2) web strands: the subordinate ideas generated by the students that help to clarify the core concept or question;
3) strand supports: details and generalizations that help to clarify and distinguish the strands;
4) strand ties: depict the relationships among strands.

For additional material on semantic mapping, see Heimlich and Pittleman (1986).

Strategies to Activate Curiosity

In order to stimulate reading motivation several strategies are may be employed in science and STS:

- brainstorming: in small groups, students generate a list of words related to the main topic of a text. Following that, the students arrange the words into subcategories, explaining the logic behind each arrangement. After discussing the words and the arrangements, students are asked to make predictions about the content of the reading assignment.

- creating conceptual conflicts: confrontations with situations that create puzzlement, doubt, or contradiction may become a driving force for the search for knowledge. STS issues provide excellent sources of such situations. Examples are: 1) the creation of problematic situations, which are discussed prior to reading, to provide initial awareness. Reading material should be selected by students or assigned that will help the students to investigate and solve the problem. 2) assigning roles or perspectives to the students, which they should maintain as they read written material. This helps them to get "into" reading to investigate and solve assigned questions.

Prediction Strategies

To make predictions about the content prior to reading, students must activate their previous knowledge and experiences. Their motivation may be increased when they discover that what they already know is relevant to a new topic.

- anticipation guides. These guides consist of a list of statements to which each student responds prior to reading. During the discussion after the reading, the students compare their responses with each other while the teacher's role is to activate thought and motivation.

- student-generated questions. Students can approach a reading assignment by asking. "What do I think this selection is about?" and "Why do I think so?" The predictions and prior knowledge activated by the attempts to answer these questions will focus the reading task more clearly. Two strategies that can be employed are the Expectation Outline and Your Own Questions. Quidelines for and examples of these prediction strategies can be found in, Herber (1978) and Vacca and Vacca (1986).

C. STRATEGIES DURING READING

While the ultimate purpose of science reading is to show students how to learn independently from texts, many students need some guidance in dealing with the conceptual demands of texts. In this section several kinds of reading guides will be discussed.

Reading or study guides are teacher-constructed adjunct instructional materials, meant to provide support for students as they form concepts. These guides are an essential tool for maturing readers, who need modeling and guidance learning why, when, and how to read. Herber (1978) maintains that reading and study guides simplify difficult text for readers. A distinction can be made between interlocking and noninterlocking guides. An interlocking guide assumes a hierarchical relationship from the level of literal, through interpretive to applied comprehension. Noninterlocking guides require students to search for relationships while reading, switching among the different levels.

Interlocking guides:

- Three-level guides stimulate the inductive process of thinking by providing facts, by asking readers to draw inferences, and by applying these inferences to other situations. The three levels are somewhat artificial since readers may approach a text by searching for 'higher' level inferences. In addition, the levels are probably interactive and inseparable in reading (Vacca and Vacca 1986).

  Before constructing a guide, the teacher should decide what information should be emphasized and how much assistance the students will need. For examples of construction guidelines for different context areas, see Thelen (1984); Herber (1978); Vacca and Vacca (1986).

- Pattern guides focus on simplifying of the structure of a text. They help make making students aware of the relationships that predominate in a text. Perceiving text structure is one of the most difficult and essential reading activities. Discussion among students increases their awareness of how the author uses a pattern to structure information. Vacca and Vacca (1986) provide guidelines for and examples of interlocking guides for different content areas.

Non-interlocking guides:

In these guides, written questions are asked in relation to important parts of the reading tasks.

Studies regarding the most effective position for questions indicate that post-reading questions inserted in the text following the sections in which the answers could be found produced a greater recall of information (Vaughan 1982; Vacca and Vacca 1986). However, in these studies the questions were limited to factual questions. Teachers may want to use questions that require an interpretial response. (For examples of noninterlocking guides, such as a Planning Chart and a "Guide-O-Rama", see Vacca and Vacca [1986]. See Thelen [1984] for a simple level guide).

D. POSTREADING STRATEGIES

Comprehension of the content can be reinforced by postreading review and reflection. Research indicates that postreading questioning in the form of application or inference questions is likely to facilitate learning (Vaughan, 1982). Several authors report a lack of research on specific issues related to postreading questioning, such as the effect of text-type and pertinent feedback.

Another activity intended to facilitate postreading recall involves Manzo's (1975) guided reading procedure. Based on what the students remember, the teacher guides the students in modeling the process of organizing and associating concepts. This strategy is more effective when used in combination with prereading activities (Vaughan 1982).

For the purpose of independent learning, student-directed activities are more appropriate. An example is the graphic postorganizer, which is used similarly to the advance organizer. Semantic mapping may be used as another student-directed postreading strategy (it is discussed earlier in the section on prereading activities).

Herber (1978) emphasizes the importance of postreading and nonprint-related reasoning. In order to foster independent reasoning, students should be taught how to apply the reasoning process effectively. He recommends a functional approach in which the reasoning process is simplified, but not fragmented into subskills. How to simplify reasoning for teaching purposes is not quite clear, but Herber makes an attempt by making abasic distinction between open and closed reasoning to replacethe seven distinctions he found in the literature.

VI. STUDY STRATEGIES AND INDEPENDENT LEARNING

"As students become more aware of reading processes - for example, how to identify important ideas in text - they become better able to use and monitor strategies for studying" (Vacca and Vacca 1986, pp. 251-252). The task of the teacher is to show the students how to study written materials effectively, so that they can be in charge of their own learning. Suggested are the following strategies:

- Previewing and skimming. These activities make students aware of the purposes for a reading task and help them to plan how to tackle it. Teachers can help by clarifying the questions the student must ask to analyze the task and can make recommendations such as reading the first sentence of every paragraph or skimming an entire reading selection very quickly.

- Outlining. Outlying helps students to follow the way authors develop their ideas and to distinguish between main ideas and supporting ideas and details. An outline can be used as a guide for studying. For students who are not yet mature readers, a visual display is more helpful than the more conventional form of hierarchical ordering of ideas in a linear way. Examples of visual displays are.

- the array procedure. Words, lines, and arrows are used to create a logical spatial arrangement among key words and phrases that are identified by the teacher (in a later phase the students can generate these themselves). The connections between key words and phrases can take on different forms and their correctness can be argued by the students.

- semantic webbing (or semantic mapping). This procedure is similar to the array procedure but is more detailed. Further detail is given in Heimlich and Pittleman (1986).

A minor disadvantage associated with visual displays relates to the problem of displaying subordinate details (for examples, see Vacca and Vacca [1986]).

- Note-taking. The reason for taking notes is to maximize recall of information. Although essential for learning, it is a relatively neglected area of study instruction. Reading notes can take several forms, but should avoid verbatim reproductions.

  Eanet and Manzo (1976) make a distinction among:

- the summary annotation that concisely condenses the main ideas of a passage;
- the thesis annotation that identifies the author's theme;
- the critical annotation that is the student's response to the author's thesis;
- the question annotation that poses the main theme as perceived by the reader in the form of a question (Vacca and Vacca 1986).

A "thought book" containing reading notes should be kept by students in order to make note-taking a regular activity.

- Graphic Aids. An author uses graphics for certain purposes, while students tend to pay little attention to them. Teachers can help students use graphic aids for organizing information and improving understanding.

Following Summers (1965), Vacca and Vacca (1986) present four recommendations that would lead to an effective use of graphics in content areas. Teachers should teach students to

1. recognize and interpret separate elements presented in graphic aids;
2. analyze and understand the relationships between these elements;
3. ask questions and search for answers through the use of graphic aids; and
4. draw inferences and conclusions from graphics with respect to the problem at hand.

In open-book discussions, the teacher can direct the students through an analysis of a graphic aid by modeling the questions students should ask when they encounter graphics in their texts. (See Vacca and Vacca [1986], for a list of the interpretive skills students need for the different forms of graphic aids.)

VII. VOCABULARY AND CONCEPT DEVELOPMENT

Vocabulary studies in content areas often focus on the acquisition and expansion of word definitions and word meanings. However, reading comprehension also requires an understanding of how terms relate to one another conceptually and how terms are defined by the context of the reading passage. Concept development is the appropriate framework within which vocabulary should be taught and reinforced. Herber (1978) uses the term vocabulary development to capture both vocabulary and concept development in the content areas. He uses Goodman's definition (1970): "vocabulary development is the ability of the child to sort out his experiences and concepts in relation to words and phrases in the context of what he is reading" (p. 133). The distinction between a word and a concept is characterized by Vacca and Vacca (1986) as representing more than the meaning of a single word. Concepts provide in short form what it might take many words to describe. Concepts are mental images that mostly represent a general class linked by common characteristics. Concepts are learned best by manipulative, purposeful experiences, while in content material, students are confronted with many special and technical words that don't have concrete referents (Dupuis and Snyder 1983).

Vocabulary development, especially concept labeling, is an important component of STS Foundations, Level 1 of the STS Goal Hierarchy (Rubba, 1988). The definitions of scientific terminology and the relationships among concept labels will require careful instruction. Minority students will need practice in working with the terminology and becoming comfortable with it. Only when students are comfortable with language can they use it to assess multiple viewpoints, develop problem-solving procedures, and make reasonable decisions.

Instructional strategies should emphasize 1) reinforcing of word meanings and conceptual relationships, 2) developing of inquiry skills that help the student to determine the meanings of unfamiliar words they encounter, and 3) awareness of and excitement for learning new words.

Content areas are distinguishable by their particular vocabulary. Any content area text will contain three types of vocabulary: 1) a general vocabulary that consists of everyday words having widely acknowledged meanings, 2) a special vocabulary in which everyday vocabulary takes on a meaning adapted to a particular content area, and 3) a technical vocabulary, that is used and applied only in a particular content area (Vacca and Vacca 1986; Dupuis and Askov 1982; Dupuis and Snyder 1983).

Vocabulary Reinforcement and Extension

Reinforcement activities may take place either before or after reading. Vocabulary exercises should not only reinforce definitions but should also help students to manipulate words in relation to other words.

Henry (1974) associates four basic cognitive operations with learning concepts and words.

1) the act of joining or "bringing together," which enables the students to compare, clarify, and generalize;

2) the act of excluding through which examples can be distinguished from nonexamples of a concept;

3) the act of selecting through which students make choices and "explain why based on what they experience, know or understand" (Vacca and Vacca 1986, p. 311);

4) the act of implying which refers to the ability to make decisions based on if-then, cause-effect relations among concepts and words.

Activities Related to Relationships Among Concepts:

- Word sorts: students group words, written on cards or exercise sheets, into different categories by searching for shared characteristics among their meanings. - Categorization: a more elaborate form of a word sort in which the students relate words to a more inclusive (superordinate) concept.

- Concept circles: students describe or name the concept relationship that exists among the sections of a circle in which the teacher has written words or phrases. Although similar to categorization exercises, the visual aspect of manipulating sections of a circle is appealing to students.

- Word analogies: students fill in a missing word in an analogy and explain the relationship.

- Post-reading structured overview: a post-reading version of the pre-reading strategy discussed earlier.

Activities Reinforcing and Extending Contextual Knowledge:

Using the context in which a word is embedded enables readers to recognize fine differences of meaning. Examples of activities are:

- Modified cloze passage, based on an important part of the reading assignment (see the section on readability and difficulty). The modified version may have different deletion rates and provided word lists for answers.
- Context puzzles, in which students, for example, fill in blank spaces based on structural clues of the words combined with context clues provided in sentences.
- Word puzzles, in which definitions are reinforced by associating technical terms with more familiar words.

Vocabulary Inquiry

Basic tools of vocabulary inquiry are context analysis, structural analysis, and the use of the dictionary. Teachers who show students how to use these tools assist them in building vocabulary principles so they can seek clues to word meanings on their own. When encountering an unknown word, students can use these tools and continue reading.

- Context analysis: students need guidance in using context clues that the author provides, such as typographic aids and syntactic/semantic aids.
- Structural (morphemic) analysis: by identifying the parts of an unknown word, a reader can make better guesses about its meaning.
- Using the dictionary: when a precise definition is needed or when context and structure analysis don't help much, the use of a dictionary seems to be appropriate. Supervision is often needed, for example, when several definitions for a word exist.

Vocabulary reinforcement exercises provide experiences to students in which they manipulate words in different instructional situations. For examples and more detailed descriptions of vocabulary activities, see Vacca and Vacca (1986); Henry (1974); Dupuis and Askov (1982); Dupuis and Snyder (1983).

VIII. SUMMARY AND CONCLUSIONS

The issues of metacognition, prior knowledge, transfer of skills, and the synthesis and integration of knowledge are all important bases for responses to problems of reading in Science/STS. A great deal is known about reading in content areas and a surprising amount of that work has dealt with reading in science. The importance of cognitive and concept-oriented instruction of science is well-known; hence, most of the strategies presented here are cognitive. Teachers can develop a broad repertoire of instructional strategies for reading in science, including vocabulary work, study guides, comprehension, study skills, and independent learning. These strategies will help students at all four levels of the STS Goal Hierarchy.

When we look at affective or attitude issues, science reading has also received serious study. Clearly students' background, past success, level of aspiration, interests in the material, and achievement will affect their attitudes toward reading. When students come from minority cultures, concerns for language and cultural differences compound these affective variables. We must be careful to consider these variables as we plan the Science and STS curriculum. The STS goals of awareness which leads to action requires that we work to develop positive attitudes toward the use of language and reading as tools for effective living.

Teachers who focus on Science and STS instruction can respond to and accommodate students' reading needs while they retain their central focus on the content of the Science and STS curriculum.

BIBLIOGRAPHY

ALEXANDER, C. F. (1985). "Black English Dialect and the Classroom Teacher". In Brooks, C. K. (ed.). Tapping Potential: English and Language Arts for the Black Learner. Urbana, IL: NCTE.

ALVERMANN, D., Conley, M. and Moore, D. (eds.) (1986). Research Within Reach: Secondary School Reading. Newark, DE. International Reading Association.

ANDERSON, T. H., AMBRUSTER, B. B., and KANTER, R. N. (1980). How Clearly Written are Children's Textbooks? Or, of Bladderworks and Alfa. Champaign, IL: Univ. of Illinois, Center for the Study of Reading.

AUSUBEL, D. P. (1968). Educational Psychology: A Cognitive View. New York: Halt, Rinehart, and Winston.

AUSUBEL, D. P., NOVAK, J. D. and HANESIAN, H. (1978). Educational Psychology: A Cognitive View. New York: Halt, Rinehart, and Winston.

BROOKS, C. K. (ed.)(1985). Tapping Potential: English and Language Arts for the Black Learner. Urbana, IL: NCTE.

BROWN, A. L. and PALINSCAR, A. A. (1982). "Inducing Strategic Learning from Texts by Means of Informed, Self-Control Training", Topics in Learning and Learning Disabilities, 2, 1-17.

CHAPLIN, M. T. (1986). "Implications in Personal Construct Theory for Teaching Reading to Black Students", In Brooks, C. K. (ed.) Tapping potential: English and Language Arts for the Black Learner. Urbana, IL: NCTE.

CURETON, G. O. (1985). "Using a Black Learning Style". In Brooks, C. K. (ed.) Tapping Potential: English and Language Arts for the Black Learner. Urbana, IL: NCTE

DUPUIS, M. (ed.) (1984). Reading in the Content Areas: Research for Teachers. Newark, DE: International Reading Association.

DUPUIS, M. M. and ASKOV, E. N. (1982). Content Area Reading: An Individualized Approach. Englewood Cliffs, NJ: Prentice Hall.

DUPUIS, M. M. and SNYDER, S. L. (1983). Develop Concepts through Vocabulary: A Strategy for Reading Specialist to Use with Content Teachers, Journal of Reading.

EANET M. G. and MANZO, A. V. (1976). "REAP: A Strategy for Improving Reading/Writing/Study Skills", Journal of Reading, 19:647-652.

ESTES, T. H. (1982). "The Nature and Structure of Text" In Berger, A. and Robinson, H. A. (eds.). Secondary School Reading. What Research Reveals for Classroom Practice. Urbana, IL.

ESTES, T. H. (1971). Scale to Measure Attitudes Toward Reading, Journal of Reading, 15:135-138.

FINCH, J. B. (1985). "Tips: Deciphering Dialect", In Brooks, C. K. (ed.) Tapping Potential: English and Language Arts for the Black Learner. Urbana, IL: NCTE.

GOODMAN, K. (1970). "Behind the Eye: What Happens in Reading", In Reading Process and Program. Urbana, IL: National Council of Teachers of English.

HEIMLICH, J. E. and PITTELMAN, S. D. (1986). Semantic Mapping Classroom Applications. Newark, DE: International Reading Association.

HENRY, G. H. (1974). Teaching Reading as Concept Development: Emphasis on Affective Thinking. Newark, Del.: International Reading Association.

HERBER, H. L. (1978). Teaching Reading in Content Areas. Englewood Cliffs, N.J.: Prentice-Hall.

IRWIN, J. W. and DAVIS, C. A. (1980). "Assessing Readability: The Checklist Approach", Journal of Reading, 24:124-130.

KLARE, G. R. (1974-75). "Assessing Readability", Reading Research Quarterly, 10(1), 62-102.

LANGER, J. A. (1981). "From Thesis to Practice: A Prereading Plan", Journal of Reading, 25:152-156.

LEHMAN, J. D., CARTER C. and BUTLER KAHLE, J. (1985). "Concept Mapping, Vee Mapping, and Achievement: Results of a Field Study with Black High School Students", Journal of Research in Science Teaching, 22(7): 663-673.

LEWIS, R. and TEALE, W. (1980). "Another Look at Secondary School Students' Attitudes Toward Reading", Journal of Reading Behavior, 12:187-201.

LOTT, G. W. (1983). "The Effect of Inquiring Teaching and Advance Organizers Upon Student Outcomes in Science Education", Journal of Reasearch in Science Teaching, 20(5): 437-451.

MANZO, A. V. (1975). "Guided Reading Procedure", Journal of Reading, 18:287-291.

MEYER, B. J. F. (1975). The Organization of Prose and Its Effect in Memory, Amsterdam: North-Holland.

MEYER, B. J. F. and RICE, E. (1984). "The Structure of Text", In P. D. Pearson (ed.) Handbook of Reading Research, pp. 319-352. New York: Longman.

NILES, O. (1964). "Developing Basic Comprehension Skills", In J. Sheck (ed.), Speaking of Reading. Syracuse, New York: Syracuse University Reading and Language Arts Center.

PERRY, J. (1985). "Language Tips: The Black Ebonics Speaker and the Reading Process", In Brooks, C. K. (ed.). Tapping potential: English and Language Arts for the Black Learner. Urbana, IL: NCTE.

STAUFFER, R. (1975). Directing the Reading - Thinking Process. New York: Harper and Row.

SUMMERS, E. (1965). "Utilizing Visual Aids in Reading Material for Effective Learning", In H. L. Huber (ed.), Developing Study Skills in Secondary Schools. Newark, Delaware: International Reading Association.

THELEN, J. N. (1984). Improving Reading in Science. Newark, Del.: International Reading Association.

TIERNEY, R. J. (1982). "Learning from Text", In Berger, A. and Robinson, A. H. (eds.). Secondary School Reading. What Research Reveals for Classroom Practice. Urbana, IL: Eric Clearinghouse.

TROUT, J. S. and CRAWLEY, F. E. (1985). "The Effects of Matching Instructional Strategy with Selected Student Characteristics on Ninth Grade Physical Science Students' Attitudes and Achievement", Journal of Research in Science Teaching, 22(5): 407-420.

TURNER, D. T. (1985). "Black Students, Language, and Classroom Teachers", In Brooks, C. K. (ed.). Tapping potential: English and Language Arts for the Black Learner. Urbana, IL: NCTE.

VACCA, R. T. and VACCA, J. L. (1986). Content Area Reading, (2nd ed.) Boston: Little, Brown and Company.

VAUGHAN, J. L. (1982). "Functional Strategies", In Berger, A. and Robinson, A. H. (eds.). Secondary School Reading. What Research Reveals for Classroom Practice. Urbana, IL: Eric Clearinghouse.

WEAVER, P. and SHONKOFF, F. (1978). Research within Reach: a Research-guided Response to Concerns of Reading Educators. St. Ann, MO: Central Midwestern Regional Educational Lab.

WETMORE, M. E. (1982). Improving the Comprehensibility of Text. Unpublished manuscript.

Toward A Black Studies -- S-STS Interface

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Introduction

> "[Educational institutions] must become not simply a center[s] of knowledge, but ... center[s] of applied knowledge and guide[s] of action. And this is all the more necessary now since we easily see that planned action especially in economic life is going to be the watchword of civilization...starting with present conditions and using the facts and the knowledge of the present situation of American Negroes, the [education of Black Americans must] expand toward the possession and the conquest of all knowledge. It seeks from a beginning of the history of the Negro in America and in Africa to interpret all history; from a beginning of social development among slaves and freedmen in America and Negro tribes and kingdoms in Africa, to interpret and understand the social development of all mankind in all ages. It seeks to reach modern science of matter and life from the surroundings and habits and attitudes of American Negroes and thus lead up to understanding of life and matter in the universe." [Du Bois (1933;68)]

Du Bois' classic statement articulated some 50 odd years ago suggests remarkable similarities to selected perspectives advanced by contemporary STS advocates. As an illustration, Waks (1987;4) has coherently summarized early themes advanced by STS proponents that shaped the initial evolution of the enterprise as follows:

(1) A rejection of "normal" disciplinary approaches to their topics, and indeed a rejection of the organization of intellectual life in academic disciplines;
(2) A rejection of the secular "scientism" which had dominated work in all intellectual disciplines including the humanities through the twentieth century;
(3) A fundamental rejection of mainstream educational institutions... that went beyond a call for educational reform, and extended to a critique of education in industrial society.

Despite obvious parallels in the concerns of Du Bois and S-STS advocates, only recently have formal efforts been made to connect the systematic study of the Black experience and the STS movement. Moreover, even these preliminary efforts at cooperation are problematic because it is not at all clear that the generalized STS perspectives adequately address the particular ways in which modern science and technology have affected and continue to affect African-Americans.

A similar reservation can be advanced concerning the curriculum materials developed to implement S-STS approaches in the K-12 curriculum. Both the global critiques and the curriculum materials project a traditional mono-cultural interpretation of science and technology. This interpretation ignores cultural diversity in the development of science and technology, the problems of unequal access to benefits and the differential costs associated with technological change imposed upon certain populations as a result of institutional racism.

Science education, in general, has sought to limit artificially the domain of cultural diversity. The myth of scientific universality and objectivity persists despite the growth of a large body of literature that documents differences in patterns of conceptualization and knowledge production across cultures [Horton (1967)].

Some reformers are seeking to address these issues by transfusing traditional STS curricula using insights from specialists in the field of multi-cultural education. Despite similarities between the goals and content of multi-cultural education and Black Studies the two enterprises are different in important respects. In fact, an STS-Multi-cultural educational partnership is far easier to achieve than an STS-Black Studies synthesis. The development of Black Studies has focused largely on the areas of inquiry typically associated with the humanities and the social and behavioral sciences. Black Studies as a cognate area is almost invisible within colleges or schools of education. Moreover, despite its institutionalization within higher education, Black Studies has been, and remains, committed to a radical transformation of society generally, and educational praxis, in particular. This commitment is potentially intimidating to reformist oriented STS advocates.

At the same time, similarities between multi-cultural education and Black Studies suggests that cooperation between Black Studies and STS at some level is feasible. Similarities and differences can be seen by relating the objectives of Black Studies to the various approaches to multi-cultural curriculum reform identified by Banks (1988). Banks delineates four possible levels of integration of "ethnic content" into curricula. Level 1 is described as the "contributions approach" which focuses on presenting information about individual heroes, holidays, etc., in a way that leaves the mainstream curriculum unchanged. According to Banks, this approach "often results in the trivialization of ethnic cultures, the study of their strange and exotic characteristics, and the reinforcement of stereotypes and misconceptions". Level 2 is described as the "ethnic additive approach" which involves adding new content, concepts, themes, and perspectives to the curriculum, while retaining its basic structure. Banks indicates that one weakness of this approach is that "it usually results in the viewing of ethnic content from the perspectives of mainstream historians, writers, artists, and scientists because it does not involve a restructuring of the curriculum. The events, concepts, issues, and problems selected for study are selected using Mainstream-Centric and Euro-Centric criteria and perspectives".

The third level, the transformative approach, "changes the basic assumptions of the curriculum and enables students to view concepts, issues, themes, and problems from several ethnic perspectives and points of view" designed to "extend students' understandings of the nature, development, and complexity of U. S. society". The fourth level, which Banks characterizes as "The Decision-Making and Social Action Approach," it is suggested, "adds components that require students to make decisions and to take actions related to the concept, issue or problem they have studied in the unit".

These four approaches can be juxtaposed to the conceptions of Black Studies described by Allen (1974). Allen lumped the various conceptions that have been advanced into three general categories: (1) an academic conception whereby the mission of Black Studies is to research Black history and illuminate the contributions of Blacks; (2) an ideological political conception whereby Black Studies is seen as an instrument of cultural nationalism; and (3) an instrumental political conception whereby Black Studies is considered to be a vehicle for social change with a functional relationship to the Black community. Banks' Level 1 is purely and simply an unauthentic approach from the vantage point of Black Studies. The forcefulness of this rejection is in part a response to early efforts to neuter Black Studies described, for example, in Allen's assessment that "some schools simply took all their courses touching upon race relations and minority groups, lumped them together and called this potpourri Black Studies". Allen's first conception of Black Studies is an amalgam of Banks' levels 2 and 3.

The second and third conceptions correlate to Banks' third and fourth levels with the important distinction that cultural nationalism does not equate with ethnic inclusion. The nationalist conception makes contribution of a body of knowledge to the liberation of Blacks a criterion of evaluation that has two important ramifications. First, according to Jackson (1970), scholarship must be utilitarian, i.e. geared toward "...improving life in the black community" reflecting a close "relationship between pure and applied roles of science, with a greater stress on application of knowledge". Second, alliances and comparative analyses have a low priority because, Jackson asserts, "the thrust of Black Studies Programs must remain at the level of a movement...resist[ing] institutionalization and any partnership which is not pluralistic, humanistic in function, and integrally related to the liberation and restoration of all Black people," and "as instruments for the development of the Black community...[must] not become token instruments for the legitimation of white institutions of higher education".

Partnerships between Black Studies and other fields of inquiry are also constrained by the Black Studies' connection to the social sciences. This connection has produced an intensive focus on paradigm development grounded in the ontology of "Afro-Centricity". Afro-Centricity in the words of Asante (1987;125), "is the most complete philosophical totalization of the African being-at-the-center of his or her existence. It is not merely an artistic or literary movement. Not only is it an individual or collective quest for authenticity, but it is above all the total use of method to effect psychological, political, social, cultural, and economic change. The Afro-Centric idea is beyond decolonizing the mind".

This ontology necessitates an emphasis on the examination of Blacks as actors rather than as victims in Black Studies analyses. As noted by Wilcox (1976), this requires "the development of new definitions of old perspectives". As an example, in the study of the slavery era, traditional perspectives focus on mistreatment-treatment of slaves, destruction of the Black family, the breaking of cultural ties with Africa, etc. In contrast, a bonafide Black Studies analysis would focus on resistance to slavery involving the cooperative efforts of free Blacks and slaves including slave revolts and sabotage, the preservation of family relationships despite massive efforts to prevent such, and cultural survivals. The Black Studies paradigm necessarily emphasizes historical analysis. Karenga (1982;42-43) argues for a hierarchical position for historical analysis in the following terms: "Black Studies...begins with Black History because it is relevant, even indispensable to the introduction and development of all other subject areas. Black History places them in perspective, establishes their origins and development, and thus, aids in critical discussion and understanding of them. Moreover, each of the other subject areas of Black Studies teaches its own particular history which in turn is a part of general Black history. Black history, then, offers not only a broad framework for critically viewing and understanding Black people, but also a necessary background perspective for critical insights into other subject areas of Black Studies".

The Afro-Centric ontology also mandates an intensive focus on the African-American experience as opposed to seeking to compare the experiences of other groups with that of Afro-Americans. This approach avoids critical omissions that limit the explanatory power of a historical cross-cultural model. Moreover, the intensive focus allows a cross-check in the appropriate use of concepts, models, and terminology to describe experiences of particular groups. In contrast, some so-called multi-cultural perspectives retrogress into vague generalities that simply restate traditional Euro-Centric perspectives. One example is provided by the model of "caste-like" minorities used by Ogbu (1985) to describe the contemporary experiences and behaviors of inner-city youths. The use of the concept of caste in his model is totally disconnected both from the historical usage of this concept, as well as from the history of the Blacks generally.

Scholars whose analyses are consistent with the intellectual tradition of Black Studies always focused on the interaction among class, caste, and race as factors influencing the experiences of African-Americans. From this perspective, the usefulness of the concept of "caste status" is limited to describing the aggregate relationship between Blacks and Whites related to historical periods during which the ability of Black elites to separate themselves spatially and consciously from the Black masses was limited. It was, in fact, the breakdown of "caste", not its reemergence that have contributed to the current barriers to "positive" socialization of youth in inner-city communities. Caste status is clearly not a satisfactory explanation of the behavior of disconnected inner-city youth given the phenomenal growth of a Black middle class with many fewer barriers to upward mobility than was the case in earlier eras. Even here, however, the use of the concept of caste is problematic. To illustrate, Cox (1948) clearly delineated the weaknesses of the concept for describing the experiences of African-Americans:

"The caste system is not a social concept in the sense that social status is one. Social status is a universal attribute of human societies. But the caste system is not merely an attribute of society; it is itself a type of society. It will make no sense at all to speak of a caste society as an attribute of a capitalist society. These two are distinct social systems, with entirely independent cultural histories and with mutually antagonistic social norms. It is beyond all social logic, moreover, to conceive of a caste system developing spontaneously within a capitalist system. We cannot even conceive of social status, as it manifests itself in the caste system, having an identical or similar manifestation in the capitalist system.

A concept which changes its meaning according to the convenience of the student may complicate rather than clarify thinking on the subject.

To be sure, no one need be overmeticulous about an offhand use of the term 'caste' in discussions of race relations. In formal sociological writings, however, its indiscriminate use may be insidiously misleading. Indeed, attempts to give the vulgar use of this term scientific precision have probably divested it of much of its former odium. In the sociology books it has been objectified and desiccated so that race relations in the Southern states, for instance, are sometimes made to appear as one of the natural forms of social organization. The idea of a 'type of society' obscures the actual pathological racial antagonism, leaving some diffused impression that it is socially right, even as the caste system in India is right.

The terms 'race prejudice' and 'racial discrimination' have already been defined in the world view of Western society as social sins per se. However, such subjects as race prejudice and discrimination call for delicate handling in the textbooks. Consequently many writers will find it more incommodious to discuss and explain these phenomena than to couch the situation in the euphonious terminology of 'American caste'".

A legitimate Black Studies analysis of the forces shaping the values, behaviors, and life chances of highly disconnected urban youth would carefully reinterpret and relabel the experience as, for example, "institutional decimation" (Stewart;1978) and locate the problem in the historical forces of Southern to Northern migration and the decline of caste mentioned previously. Intervention proposals would recognize the historical importance of peer groups as socializing agents in traditional Africa and Afro-America and focus on how to alter the focus of peer group activity using the Guardian Angels, successful chess clubs and similar extra-curricular activities, and community group sponsored projects like Boys Clubs as exemplars. Consistent with the perspective of Black Studies, however, only wholesale societal transformation will alter the circumstances of the most disconnected youth. Interim solutions are most likely to be effective outside of traditional educational and economic institutions. Even in the case of less disconnected youth, Black Studies intervention strategies do not rely on transformation of the educational establishment through enlightenment of controlling interests. Rather, Black Studies has established strategic alliances with groups including the National Alliance of Black School Educators, the Assault on Illiteracy, and the Institute for Independent Education to pursue its transformational objectives.

For the purposes of this project, incorporation of a Black Studies perspective is constrained by the STS approach to curriculum reform targeting public schools in particular. Even within this restricted range of concerns, a viable Black Studies-STS initiative requires pushing the Black Studies paradigm beyond its present limits because issues related to science and technology are typically not addressed directly. This extension must analyze both the pre-slavery/pre-capitalism era in Africa and the experiences of peoples of African descent in the Americas, and demonstrate the relevance of this material for contemporary concerns. Several assumptions underlie this approach to curriculum modification. These include:

(1) Including material in the science curriculum that highlights scientific and technological developments in ancient Africa and among African-Americans can motivate students to consider advanced course work in science and technology related areas;
(2) Encouraging students to replicate laboratory experiments that were critical in the work of African-American scientists and inventors can enhance understanding of the scientific method and of laboratory techniques while also increasing their motivation to study science;
(3) Encouraging students to undertake science projects that relate directly to their day to day experiences in their own environments can increase their interest in, and awareness of, the implications of modern scientific and technological developments on specific population groups; and
(4) Inclusion of materials focusing on Africa, African-Americans and science and technology in areas of the curriculum other than science such as literature and history and in non-traditional courses as science fiction and future studies can complement modified science modules.

The task of integration of STS and Black Studies is facilitated if (a) technology is conceptualized broadly, (b) the relationship between technology and other social systems is properly understood, and (c) an historical approach to the analysis of technological change and its impacts is utilized which does not delimit history to traditional "western civilization" approaches.

The rudiments of such a theoretical synthesis already exist and are presented below.

Science, Technology and the Black Experience: An Overview

The conventional wisdom about ancient, and even modern, Africa projects images of pre-industrial, under-developed African villages struggling to produce the means of subsistence using low technologies. From this vantage point, contemporary problems are defined, in part, as under-development resulting from the lack of evolution of technological means. In contrast, more recent research is amassing evidence of a "high" technology that both preceded and paralleled the "low" technology. This high technology produced advances in navigation and exploration, steel making, astronomy, aeronautics, medicine, mathematics, etc. that either equals or exceeds comparable technologies produced much later in Europe and in the United States. [Van Sertima (1984)]. One of the contemporary areas of research in Black Studies is the search for explanations of how the "high" technology was "lost" or destroyed, leaving the "low" technology as the only visible symbol of African development.

It has been hypothesized by some that much of the "loss" of African high technology was the direct result of the early European invasions and the later invasions associated with the era of slavery and the slave trade.

The demand for large numbers of slaves presumably led to a concentration of slave catching activities around large populations centers, where high technology was also concentrated. Disruption of these centers both aborted the diffusion of high technology to the hinterlands and destroyed indigenous technological development capacity. Effective resistance to the European invasion was not possible because of the relative "under-development" of weapons technologies in Africa.

The presence of a lost "high technology" creates the possibility for a new approach to the search for "appropriate technologies" in Africa. Such an approach would involve coordinated efforts to uncover the remnants of, and resurrect and adapt ancient "high technology" for contemporary usage. Examples include traditional methods of food preservation and healing. This approach need not be in conflict with the transfer of "appropriate technology" from the West, instead it can provide a cross check and an opportunity to integrate different technological approaches. To illustrate, most of the scientists and researchers currently examining traditional technologies have been trained in the West and are able to use modern science to understand why traditional technologies work.

One of the implications of this approach to the study of the relationship of Africa to the development of Western science and technology is that it allows a parallel treatment of the relationship of African-Americans to that developmental process. In particular, the West was first able to achieve technological leaps through the forcible transfer of early "high technology" from Africa. The second wave of invasions redefined the function of Africa in the world order from technological innovator to a source of cheap labor to fuel economic growth.

The relationship of African-Americans to Western science and technology can be modeled as the continuation of these patterns via the establishment of mechanisms to control and direct African-American technological developmental capacities. This allowed the principal direct benefits of technological innovations to be siphoned off while also exploiting African-Americans as a source of cheap labor to support new technologies.

Once the process of technological development was harnessed to the engines of capitalism, an extremely important development emerged, the phenomenon of short cycles and long waves of economic expansion and decline. Yet, long wave theory provides a powerful means of modeling the relationship between economic, political, and social institutions and the process of technological change.

Long waves refer to systematic long-term fluctuations in selected price, production, and consumption series analyzed first by Soviet economist, N. D. Kondratieff and Dutch economists, J. van Gelderen and S. de Wolff. The periodicity of long waves in the United States has been estimated by various authors to be between 40 and 65 years, with the highest points occurring in approximately the years 1815, 1870, 1920, and 1970. The troughs associated with the three earliest waves occurred around the years 1790, 1850, and 1895. [See Kondratieff (1935); Rostow (1975)]

The attractiveness of long cycle theory for present purposes stems, in part, from the potential usefulness for modelling domestic racial conflict as an endogenous phenomenon, as well as recognizing that technological changes drive long run changes. Some analysts assert that the social and political milieu during upswings and downturns differ markedly. During the expansionary period it is alleged that increased pursuit of hedonistic satisfaction leads to loosening of social constraints, weakened group attachments, and greater belief in individual capacity to affect one's own destiny. During downturns, it is asserted that agents band together into groups to protect themselves and are less adventurous and consequently the social unrest takes on a different form than during prosperous times. This sense of community, however, is allegedly founded on traditional conservative values.

Patterns of social, cultural and technical innovation among Blacks have been consistent with, and integral to, innovative activity precipitating Kondratieff upswings. In addition, economic inequality between Blacks and Whites has been exacerbated by the exclusion of Blacks from early participation in sectors providing momentum for Kondratieff upswings. As a result, the relative political-economic status of Black improves primarily during the late stages of upturns and deteriorates during downturns. Partially as a consequence, political-economic conflict between Blacks and Whites decreases during upturns and increases during downturns.

Contemporary trends in the political-economic status of Blacks and patterns of Black/White conflict display a high degree of similarity to their counterparts in previous waves, despite qualitative and quantitative differences in underlying structural characteristics. These similarities provide one vehicle for transforming historical treatments into strategies for addressing current and future problems.

Given this overview, the next section presents selected specific topics/issues amenable to a Black Studies-STS treatment. For each topic/issue, the level of treatment using Banks classification system is indicated. Although, as indicated previously, the approach Banks labelled as

Level 1 is antithetical to Black Studies, for each topic/issue, a Level 1 treatment is also indicated as a point of reference. Precedent for the general approach adapted here are found in materials developed for the Portland, Oregon School District entitled "Afro-Americans Contributions to Science and Technology" and in the document Science, Technology and Mathematics: The Black Contribution 1988 prepared by the Division of School Equity of the Pennsylvania Department of Education. Tables providing concise treatments of selected topic/issues are presented in lieu of extensive narrative discussions.

Black Studies-STS Curriculum Development -- Selected Examples

In this section six (6) issues/topics are selected to generate examples of a synthesized Black Studies/STS approach. Tables summarizing key aspects of appropriate treatment for each of the four levels of examination identified by Banks are provided. The tables preclude the need for in-depth discussion of each topic and treatment. As a consequence, the discussion that follows is designed only to highlight selected foci.

Table 1 presents treatments of the issue of the presence of "high technology" in Ancient Africa comparable, in many respects, to modern technology. Specific areas of high technology are identified. Detailed discussions can be found in Van Sertima (1984). Key areas of emphasis are (1) the destruction of the sources of much of the ancient technology via the slave trade, (2) the linkage of scientific and technological development to other spheres of human society, and (3) the possibility of adapting ancient technologies to address contemporary problems, for example food storage. An additional benefit of this approach is to create cognitive dissonance with respect to traditional views of Africa that can enhance self-esteem and facilitate constructive dialogue between peoples of African descent in various parts of the world.

Table 2 focuses on inventions and related contributions to Western technology. The material is generally self-explanatory. The key point of emphasis is the difference between Level 1/Level 2 treatments and Level 3/Level 4 treatments. Level 3 treatments allow the linkages between African and African-American involvement in contributing to scientific and technological change to be explored. Level 4 treatments are designed to affect the motivation of individuals to become involved in shaping the future course of scientific and technological developments as opposed to the "celebration of past achievements approach" implicit in Levell/Level 2 approaches.

Table 3 examines the other direction of the flows between scientific and technological change and the experiences of African-Americans. It examines African-Americans as receivers rather than as producers of scientific and technological impacts. Economic exploitation is the central motif that guides the concepts that are emphasized. The Level 2/Level 3/Level 4 treatments are all designed to provide an historical focus on contemporary issues related to economic transformation in the United States and in the world. One goal is to stimulate comparisons and contrasts between previous and the current transformations. These comparisons can facilitate the career planning by youth with limited knowledge about how broad based changes in occupational opportunities occur. The underlying construct is central to the treatments in Tables 2 and 3 is the notion of long cycles introduced previously. As an example, the various social, political, and economic developments that occurred between 1865 and 1900 bear remarkable similarities to patterns emerging since the 1960s [See Stewart (1986)]. Another important focal point is the historical origins of contemporary economic problems, for example youth unemployment.

To illustrate, the invention of the mechanical cotton picker in the 1950s and the growing use of chemical fertilizers eliminated one of the major sources of employment for Black youth. At the same time, changes in the technology of mass production in urban centers were making it cost-effective to relocate to suburban areas. As a consequence, Blacks who were pushed out of the agricultural sector and migrated North, found insufficient numbers of unskilled jobs to offset losses in the agricultural sector.

The fourth table focuses on a more specialized topic, health care, health care professionals, and the health care establishment. Given the continuing interest of many "minority" youth in the field of medicine, a Black Studies-STS approach to medical training and medical practice would be desirable. A more generalized STS module could be developed using the proposed treatments as a point of departure.

The fifth table addresses a topic for which STS modules have been developed, i.e. the environment. The proposed treatments emanate from the linkage between the forces that stimulated Black urbanization and those that produce disproportionate exposure to environmental hazards. In addition to the topics suggested in the table, to the extent that urban areas are higher probability targets for nuclear attacks, Blacks suffer disproportionate risk from the technology of nuclear warfare. It is also significant that the sister plant to the Union Carbide pesticide plant in Bhopal, India that produced an unparalleled catastrophe is located near a predominantly Black institution of higher education in West Virginia.

Recently, Kenyan President Daniel Arap Moi has condemned the wanton dumping of industrial toxic wastes in Africa by industrialized nations describing it as "a more subtle from of imperialism". He said that Africa long rejected all forms of external domination and will not allow it to come back through "the back door" in the form of "garbage imperialism".

President Moi called on the United Nations Environmental Programme (UNEP) to devise ways and means of warding off attempts to turn the African continent into a dumping round. The Executive Director of the UNEP, Dr. Mostafa Tolba, has sounded a strong warning on international dumping of hazardous wastes. He told a meeting of diplomats accredited as Permanent Representatives to UNEP in Nairobi, that he will not accept anything less than a "strong and solid" international agreement on trans-boundary movements of hazardous wastes.

Table 6 presents an example of how a synthesized Black Studies-STS perspective can be conjoined with selected highly specialized topics, space science, space exploration, and future studies more generally.

Aside from the specific topics presented in Table 6, a number of other critical issues can be identified easily as in the conclusion below.

Conclusion

No proposal for a Black Studies-STS synthesis can be useful without considering the implications of the micro-computer as a liberating educational technology. The increasing use of micro-computer assisted instruction techniques in education simultaneously introduces additional barriers and new opportunities to move in new directions. [See Harvey (1983); Hendrix et. al. (1984)] Unfortunately, both the hardware and software currently available are underdeveloped with respect to multi-cultural perspectives. The language and syntax programmed into computer chips reflects a particular cultural bias. One approach to overcoming this problem is currently being used by a private Jewish school in New Jersey where a chip containing Hebrew symbols has been added to an Apple IIe computer. There is, then, room for students to participate in "chip design" competition to develop hardware that will increase the power of this technology to contribute to social transformation.

Potentially fruitful computer design projects could involve using the concepts of physiotecture (the concept of design and construction emerging from intuition) and hypsotecture (structures containing a variety of urban and social services of dimensions exceeding the scale of conventional architecture capable of exerting psychological and sociological influences) to the design of alternative forms of inner-city housing. Such research could include the investigation of the benefits of special lighting and horticulture to reduce dysfunctional violence. A unique Black perspective is required in this research as a result, for example, of variations in responses to particular light frequencies among different population groups.

Waks (1987) has succinctly summarized the STS literature examining the role of citizen participation in technological development and assessment. Similar concerns have been viewed by Black Studies advocates and organizations have been structured to meet this challenge. As an example, during the late 1960s and early 1970s, organizations emerged to regulate the type of urban research performed using the Black Experience as data. As an example, the Community Research Review Committee in Boston, comprised of Black social scientists, was responsible to the community via the Black United Front. This approach can be extended to incorporate the exploration of issues related to technological impact assessment and technology development using the George Washington Carver model discussed previously using computer networking capabilities.

More generally, the Black church and the Black political establishment must be educated to play a more active role in promoting the approaches suggested in this essay. The trends described in this essay underscore the fact that continued reliance on the traditional political process rather than the decision-making processes shaping future technological development will be suicidal for, as Goldhaber (1986;31 has noted,

> "in a modern, technological society ... if we neglect these (decision-making) processes and concentrate only on governmental decisions, political activity can only become increasingly irrelevant as a means of controlling what shapes our lives."

TABLE 1

General Topic/Issues -- Ancient African and Modern" Scientific and Technological Knowledge: A Comparison

LEVEL 1 TREATMENT Identification	Identification (a) IDENTIFY AREAS WHERE ANCIENT AFRICAN TECHNOLOGIES WERE COMPARABLE IN SOPHISTICATION TO LATER WESTERN TECHNOLOGIES Examples: (1) Medical Treatment - Medicine, Knowledge of Anatomy (2) Architecture - Pyramids (3) Astronomy - Knowledge of Distant Stars (4) Aeronautics - Plans for Aircraft (5) Steelmaking - East Africa
LEVEL 2 TREATMENT Additive	New Theories/Concepts (a) TRACE THE DEVELOPMENT OF MODERN SCIENCE AND TECHNOLOGIES TO AFRICA Examples: (1) Agriculture - Yams, Cotton (2) Medicine - Pythagorus (Egypt) (3) Mathematics - Pythagorus (Egypt)
LEVEL 3 TREATMENT Transformation	New Theories/Concepts (a) LINKAGE OF SCIENTIFIC AND TECHNOLOGY DEVELOPMENT TO OTHER AREAS OF HUMAN EXISTENCE Examples: (1) Religion (2) Agricultural Seasons (b) DESTRUCTION OF ANCIENT TECHNOLOGIES Examples: (1) Slave Trade (2) Absence of Historical Records
LEVEL 4 TREATMENT Decision-Making/Social Action	Action (a) IDENTIFY CONTEMPORARY PROBLEMS WHERE MODIFICATIONS OF ANCIENT TECHNOLOGY COULD GENERATE ALTERNATIVE SOLUTIONS Examples: (1) Diseases (2) Food Storage (b) CONDUCT EXPERIMENTS/DEVELOP MODELS OF ADAPTATIONS OF ANCIENT AFRICAN TECHNOLOGIES

TABLE 2

General Topic/Issues -- Inventions and Other Technological Innovations by African-Americans

LEVEL 1 TREATMENT Identification	Contributions/Descriptions See Resources: (a) LISTS OF INVENTIONS (SEE DIGGS) (b) BIOGRAPHIES OF INVENTORS
LEVEL 2 TREATMENT Ethnic Additive	New Theories/Concepts (a) IMPORTANCE OF INVENTIONS OF AFRICAN-AMERICANS TO ECONOMIC GROWTH Examples: (1) Lubricating Device for Locomotive - Westward Expansion (2) Electric Light Bulbs - Enabling Extensive Night-Time Economic Activity (3) Traffic Light - Traffic Flows (b) IMPORTANCE OF INVENTIONS OF AFRICAN-AMERICANS FOR AMERICAN CULTURE Examples: (1) Shoe Lasting Machine - Production of Low Cost Shoes
LEVEL 3 TREATMENT Transformation	New Theories/Concepts (a) BARRIERS TO RECOGNITION OF INVENTIONS Examples: (1) Inability of Slaves to Obtain Patents (2) Mythology of Non-Contributions Found in Textbooks (b) BARRIERS TO BENEFITING FROM INVENTIONS Examples: (1) Economic Barriers Forcing Inventors to Sell Patents (2) Discrimination Against Products Produced by Blacks (c) INVENTIONS RESULTING FROM DAY-TO-DAY Work Experiences Examples: (1) Invention Related to Agriculture Reflecting the Slavery Experience (2) Inventions Based on Experiences as Apprentices to Artisans (d) CULTURAL INVENTIONS Examples: (1) Adaptations during Slavery to Overcome Barriers to the Use of Drums (2) Creation of Gospel Music by Adapting Spirituals using Pianos

TABLE 2 (continued)

GENERAL TOPIC/ISSUES -- INVENTIONS AND OTHER TECHNOLOGICAL INNOVATIONS BY AFRICAN-AMERICANS (continued)

	(3) Creation of Jazz using Trumpets, etc. (e) INVOLVEMENT OF COMMUNITY IN DETERMINING PRODUCT DESIGN Examples: (1) George Washington Carver's Field Testing at Tuskegee Institute
LEVEL 4 TREATMENT Decision-Making/Social Action	Activity (a) IDENTIFY CONTEMPORARY BARRIERS TO RECEIVING RECOGNITION FOR INVENTIONS (b) RE-CREATE EXPERIMENTS PERFORMED BY AFRICAN-AMERICAN INVENTORS (c) SURVEY NEIGHBORHOOD RESIDENTS TO DETERMINE USEFUL INVENTIONS

TABLE 3

General Topic/Issues -- Impact of Scientific and Technological Economic Opportunities of Development on African-Americans

LEVEL 1 TREATMENT Identification	Description (a) COTTON GIN (b) MECHANICAL COTTON PICKER (c) MASS PRODUCTION TECHNOLOGIES (d) DEFENSE TECHNOLOGIES (e) INFORMATION TECHNOLOGIES
LEVEL 2 TREATMENT Additive	New Theories/Concepts (a) TECHNOLOGY CREATING THE DEMAND FOR LABOR Examples: (1) Cotton Gin - Agricultural Slaves (2) Mass Production Technologies -- Unskilled Labor (b) TECHNOLOGY DISPLACING LABOR Examples: (1) Defense Technologies (2) Information Technologies
LEVEL 3 TREATMENT Transformation	New Theories/Concepts (a) BARRIERS TO BENEFITING FROM JOB GROWTH RESULTING FROM TECHNOLOGICAL CHANGE Examples: (1) Forced Relegation to Declining Sectors Not Benefiting from New Technologies (2) Deciding to Locate Employment Base (3) Restricted Access to Training (4) Limited Ownership of Enterprises Creating Jobs Resulting from Technological Change (5) Availability of Alternative Sources of Labor Limiting Mobility (b) SELF-SUFFICIENCY/ALTERNATIVE ECONOMIC STRUCTURES AS A MEANS OF CONTROLLING AND BENEFITING FROM TECHNOLOGICAL CHANGE
LEVEL 4 TREATMENT Decision-Making/Social Action	Activity (a) IDENTIFY ACTIVITIES IN THE LOCAL NEIGHBORHOODS THAT INVOLVE ADAPTING TECHNOLOGY TO MEET LOCAL NEEDS Examples: (1) Informal Car Repair Operations (2) Fabrication of Outdoor Grills from Steel Drums (b) IDENTIFY ALTERNATIVE ECONOMIC ACTIVITY THAT BYPASSES STRUCTURAL BARRIERS Examples: (1) Food Cooperatives (2) Church-Based Activities

TABLE 4

General Topic/Issues -- Medical Research and the Quality of Life Among Contemporary Africans and Afro-Americans

LEVEL 1 TREATMENT Identification	Identification (a) IDENTIFICATION OF DISEASES/HEALTH PROBLEMS Examples: (1) Infant Mortality (2) Malnutrition (3) Hypertension (4) Aids (5) Tropical Diseases (6) Alcoholism (7) Drug Abuse (8) Sickle Cell Anemia
LEVEL 2 TREATMENT Additive	New Theories/Concepts (a) HISTORY OF INSTITUTIONS PRODUCING BLACK DOCTORS Examples: (1) Howard (2) Meharry (b) ROLE OF BLACK HOSPITALS IN PROVIDING HEALTH CARE
LEVEL 3 TREATMENT Transformation	New Theories/Concepts (a) PUBLIC POLICIES AFFECTING MEDICAL TREATMENT Examples: (1) Misuse of Research - Tuskegee Experiment/Sperm Banks (2) Health Care Policies - Medicare as a Cause for Black Hospitals Closing (3) Wholistic Approaches as Alternatives/Complements to Western Medicine (4) Allocation of Research Funds - Underfunding of Research on Sickle Cell Anemia
LEVEL 4 TREATMENT Decision-Making/Social Action	Activity (a) ORGANIZE CAMPAIGN TO WRITE CONGRESSMEN TO DEVELOP SPECIAL INITIATIVES TO SAVE BLACK HOSPITALS (b) SURVEY LOCAL RESIDENTS TO DETERMINE MAGNITUDE OF HEALTH RISKS/INSURANCE COVERAGE

TABLE 5

General Topic/Issues -- Disproportional Impact of Environment Problems on African-Americans

LEVEL 1 TREATMENT Identification	Identification of Problem Areas (a) NOISE POLLUTION (b) AIR POLLUTION (c) LEAD POISONING (d) ASBESTOS (e) CHEMICAL DUMPING/HAZARDOUS ACTIVITIES
LEVEL 2 TREATMENT Additive	Key Concepts (a) ENVIRONMENTAL PROBLEMS EXACERBATED IN HIGH DENSITY POPULATION AREAS Examples: (1) Traffic Congestion -- Air/Noise Pollution (2) Population Density -- Noise Pollution (b) OLDER STRUCTURES CONTAIN MORE HAZARDOUS MATERIALS Examples: (1) Lead Plumbing Pipes (2) Lead Paint Used on Old Houses
LEVEL 3 TREATMENT Transformation	New Theories/Concepts (a) GHETTOIZATION LIMITS THE CHOICE OF RESIDENCES FOR LOW INCOME GROUPS, LEADING TO INCREASED EXPOSURE TO ENVIRONMENTAL RISKS (b) DESIGN OF INTRA-URBAN HIGHWAY SYSTEMS REINFORCES GHETTOIZATION (c) LIMITED KNOWLEDGE OF RESIDENTS LIMITS ABILITY TO AFFECT THE DECISIONS THAT DETERMINE DEGREE OF EXPOSURE TO ENVIRONMENTAL HAZARDS (d) ABSENTEE LANDLORDS RESIST MODIFICATIONS THAT REDUCE ENVIRONMENTAL HAZARDS
LEVEL 4 TREATMENT Decision-Making/Social Action	Activity (a) ORGANIZE A COMMUNITY EDUCATION EFFORT TO MAKE NEIGHBORHOOD RESIDENTS AWARE OF ENVIRONMENTAL HAZARDS (b) ORGANIZE LOCAL ENVIRONMENT IMPACT COMMITTEE TO SURVEY HOMES/MEASURE NOISE LEVELS AND AIR QUALITY

TABLE 6

African-Americans Involvement in Space Science and Space Exploration

LEVEL 1 TREATMENT Identification	Description (a) IDENTIFY AFRICAN-AMERICANS INVOLVED IN ACTIVITIES RELATED TO SPACE SCIENCE AND SPACE EXPLORATION (b) IDENTIFY SCIENCE FICTION NOVELS/FILMS THAT INCLUDE CHARACTERS/THEMES IDENTIFIABLE WITH THE AFRICAN-AMERICAN EXPERIENCE Examples: (1) "Brother from Another Planet" (c) IDENTIFY "FUTURE STUDIES" THAT INCLUDE TREATMENTS OF THE FUTURE OF AFRICAN-AMERICANS
LEVEL 2 TREATMENT Additive	New Theories/Concepts (a) EXAMINE PARTICULAR CONTRIBUTIONS OF AFRICAN-AMERICANS TO SPACE SCIENCE AND SPACE EXPLORATION
LEVEL 3 TREATMENT Transformation	New Theories/Concepts (a) IMPACT OF DISPROPORTIONATE INVOLVEMENT OF BLACKS IN SPACE SCIENCE AND SPACE EXPLORATION (b) INTERPRETATION OF RELATIVE ABSENCE OF BLACKS IN SCIENCE FICTION NOVELS (c) INTERPRETATION OF RELATIVE ABSENCE OF ISSUES OF CULTURAL DIVERSITY IN FUTURE STUDIES
LEVEL 4 TREATMENT Decision-Making/Social Action	Activity (a) ORGANIZE LOCAL CLUBS TO EXAMINE/DISCUSS FUTURE SOCIETY AND THE STATUS OF PEOPLES OF AFRICAN DESCENT (b) WRITE SCIENCE FICTION AUTHORS TO ENCOURAGE INCLUSION OF THEMES RELATED TO TRADITIONALLY EXCLUDED GROUPS

References

Allen, Robert L. "Politics of the Attack on Black Studies," *The Black Scholar* (September, 1974).

Anderson, James. *Public Policy Making* (New York: Praeger, 1975).

Arditti, Rita, et. al. (eds.). *Science and Liberation* (Boston: South End Press, 1980).

Asante, Molefi. "*Afro-Centricity: The Idea* (Philadelphia: Temple University Press, 1987).

Banks, James A. "Approaches to Multicultural Curriculum Reform," *Multicultural Leader* 1(2), Winter, 1988, pp. 1-3.

Banks, James A. "Teaching Black Studies for Social Change," in Roosevelt Johnson, ed. *Trends in Afro-American Studies* (Washington: ECCA Publications, 1975).

Barnett, Marguerite and Hefner, James. *Public Policy for the Black Community* (Alfred Publishers, 1976).

Bluestone, Barry and Harrison, Bennett. *The Deindustrialization of America* (New York: Basic Books, 1982).

Cox, Oliver C. *Caste, Clash and Race: A Study in Social Dynamics* (New York: Doubleday & Co., 1948).

Diggs, Irene. *Black Innovators* (Chicago: Third World Press, 1975).

Diop, Cheik Anta. *African Origins of Civilization, Myth or Reality*, edited and translated from the French by Mercer Cook (Westport: Lawrence Hill and Company, 1974).

Du Bois, W.E.B. "A Negro Nation Within the Nation," *Current History* XLII (1935), pp. 265-270).

__________. "The Field and Function of the Negro College," Alumni Reunion Address, Fisk University, 1933. Reprinted in Herbert Aptheker, ed., *The Education of Black People: Ten Critiques 1906-1960)* (Amherst: The University of Massachusetts Press, 1973).

Durbin, Paul (ed). *A Guide to the Culture of Science, Technology and Medicine* (New York: The Free Press, 1980).

Ferkiss, Victor. "Man's Tools and Man's Choices; the Confrontation of Technology and Political Science," *The American Political Science Review* 67(1973), pp. 973-980.

Feyerabend, Paul. "Against Method: Outline of an Anarchistic Theory of Knowledge," *Minnesota Studies in the Philosophy of Science* 4(1970).

Geertz, Clifford. *The Interpretation of Cultures* (New York: Basic Books, 1973).

Goldhaber, Michael. *Reinventing Technology: Policies for Democratic Values* (New York: Routledge and Kegan Paul, 1986).

Haber, Louis. *Black Pioneers of Science and Invention* (New York: Harcourt, Brecey and World, Inc. 1970).

Habermas, Jurgen. *Knowledge and Human Interests* (Boston: Beacon Press, 1971).

Hanson, Allen and Martin, Rex. "The Problem of Other Cultures," *Philosophy Of the Social Sciences* 3(1973), pp. 191-208.

Harbison, Frederick and Myers, Charles. *Education, Manpower and Economic Growth, Strategies of Human Resource Development* (New York: McGraw-Hill, 1964).

Harvey, William B. "Computer Instruction and Black Student Performance," *Issues in Higher Education* 9(1983).

Hendrix, Melvin K., Bracy, James H., Davis, John A., and Herron, Waddell M., "Computers and Black Studies: Toward the Cognitive Revolution," *The Journal of Negro Education* 53(1984), pp. 341-350.

Horton, Robin. "African Traditional Thought and Western Science," 37(1967), pp. 50-71; 155-187.

Jackson, Maurice. "Toward a Sociology of Black Studies," *Journal of Black Studies* 1(1970).

Jarcho, Irma. "S/T/S in Practice: Five Ways to Make It Work," *Curriculum Review*, January/February 1985, pp. 22-23.

Jones, James. *Bad Blood* (New York: Free Press, 1973).

Karenga, Maulana. *Introduction to Black Studies* (Los Angeles: Kawaida Publications, 1982).

King, William. "A Proposal to Enhance Scientific and Technical Literacy in AfroAmerican Communities," *Education and Human Ecology Journal* (forthcoming).

____________. "The Importance of Black Studies for Science and Technology Policy," PHYLON (forthcoming).

Kondratieff, Nikolai D. "The Long Waves in Economic Life," *The Review of Economics and Statistics* XVII(1935), pp. 105-115.

Manning, Kenneth. Black Apollo of Science (New York: Oxford University Press, 1983).

McClendon, William N. "Black Studies: Education for Liberation," The Black Scholar (September, 1974).

Merton, Robert. "Insiders and Outsiders: A Chapter in the Sociology of Knowledge," American Journal of Sociology 78(1972), pp. 9-47).

Ogbu, John. "The Consequences of the American Caste System," in Ulric Neisser, ed., The School Achievement of Minority Children (New Jersey, 1986).

Pacey, Arnold. The Culture of Technology (Cambridge, MA: MIT Press, 1984).

Penick, John. "10 Exemplary S/T/S Programs: The Search for Excellence," Curriculum Review, January/February 1985, pp. 22-23.

Rostow, W. W. "Kondratieff, Schumpeter, and Kuznets: Trend Periods Revisited," Journal of Economic History 35(1975), pp. 719-753.

Roy, Rustum. "The Science/Technology/Society Connection," Curriculum Review, January/February 1985, pp. 13-16.

Semaj, Leaheim Tufani. "The Black Self, Identity and Models for a Psychology of Black Liberation," The Western Journal of Black Studies 5(1981), pp. 158-171).

Skolimowski, Henryk. "The Scientific World View and the Illusions of Progress," Social Research 41, pp. 52-82.

Stewart, James B. "Black Studies and Black People in the Future," Black Books Bulletin 4(1976), pp. 21-25.

________________. "Economic Policy and Black America," in Rice and Jones, (eds.), Contemporary Public Policy Perspectives and Black America (Westport: Greenwood Press, 1984), pp. 141-156.

________________. "Long Cycles and Black Economic Development," mimeo, 1986.

________________. "The Field and Function of Black Studies," submitted to the William Trotter Institute, July 1987.

Stewart, James B. and Scott, Joseph W. "The Institutional Decimation of Black American Males," 2(2), 1978, pp. 82-92.

Toulmin, Stephen. Human Understanding, Volume 1 (Princeton: Princeton University Press, 1972).

Van Sertima, Ivan, (ed.). Blacks in Science: Ancient and Modern Transaction Books, 1984).

Waks, Leonard. "STS Education and Citizen Participation," mimeo, 1987.

Walsh, Catherine E. "Schooling and the Civic Exclusion of Latinos" Toward a Discourse of Dissonance," *Journal of Education* 169(2), (1987), pp. 115-131.

White, Leslie. "History, Evolutionism, and Functionalism: Three Types of Interpretation of Culture," *Southwestern Journal of Anthropology* I(1943), pp. 221-248.

Wilcox, Preston. "Black Studies As An Academic Discipline," *Negro Digest* (March, 1970).

Wilhelm, Sidney. *Who Need the Negro*.

Work, Schools, and Minority Youth Employment Problems: Implications for STS in Urban Secondary Education

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The difficult employment situation of black, Hispanic, and other minority youth deserves much of our attention and concern. Black youth currently experience a 29% unemployment rate, with those living in the inner city especially hard hit. This discussion summarizes and synthesizes much of the recent empirical literature dealing with black youth employment difficulties, though many of the points made might equally be made of Hispanic youth. It focuses first on what the problem is, explores a range of causes, and then considers the relations of school and work for minority youth. The intention is to pull together some of the main conclusions of research concerning this matter in order to provide a "picture" of the situation of these youth. Indications of opportunities for responsive STS education are given throughout. STS education is viewed here as a kind of general education oriented toward fine tuning traditional education at the secondary school level. But it will be clear from this discussion that secondary education needs to be adjusted to the local situation of minority youth in Urban America, while emphatically not losing its traditional strengths.

I. Post-Industrial Context of Work: America II

No discussion of work in contemporary society should omit the major revolutionary changes taking place in the world of work. Much of this is driven by the impact of revolutionary changes in technology together with the associated changes in America's industrial landscape. Richard Louv usefully distinguishes between America I as the industrial age America of urban centers, smokestack industries, labor unions, New Deal politics, and free standing single-family homes, and America II as the information age high-tech industries, home-based entrepreneurs, electronic mail, condominium community, and private services America.[1] He sees the emergence of America II amid the decay of America I.

The greatest intensity of the shift from America I to America II has occurred in cities. Louv paints a picture of cities as shifting from industrial to post-industrial economies, replacing outgoing manufacturing jobs with incoming service and information jobs. Those who inhabit central cities, especially urban minority youth, thus face a bewildering and rapidly changing job market in which blue collar work opportunities are rapidly diminishing and the new service and information work replacing it is often opaque to them, often beyond their reach. But it is not merely that urban work is rapidly changing from blue collar to white collar. Even the service and information jobs that are available are themselves undergoing rapid change. Computer programing positions may be plentiful today and replaced by self-programming computers tomorrow. Likewise, the nature of office work may change dramatically in organization and tasks as new technologies reshape the way things are done.

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[1] Richard Louv, America II, (New York, 1983).

On the one hand, the jobs in cities of America II require information age skills, and on the other hand, urban minority youth are often at such a low level of basic skills that it may be too costly or difficult to bridge the skill gap to prepare them for jobs in America II. New information age jobs in computers, electronics, and bio-technology will not be available to them. And at least some of these information age jobs will move out of the city as computer networks take hold, and employees work from their homes at the city periphery, in suburbs or exurbs.[2]

According to Louv, there will be as many as 128 million available jobs by 1990, up from a 1980 level of 105 million.[3] But if these new jobs are highly specialized information age jobs, even a high demand for jobs may not be of much use to many urban minority youth. This is especially so if the education and skill gap between minority youth qualifications and these jobs are too great for them to overcome.[4]

Finally, Louv suggests that when urban minority youth are employed, it may be in low-paying jobs typified by the fast-food industry, where there is little opportunity for career mobility. Such jobs are close to the minimum wage level, and typically lack fringe benefits. They are insufficient to provide for standardly conceived food, shelter, and clothing expenses. So those who get such jobs will become part of the working poor.

II. Information Age Skills

There should be certain cautions taken with this picture of the shift to American II. The first thing to note is that what passes for "service" jobs is very heterogeneous.[5] A cursory survey of skill requirements in health care, eating and drinking establishments, education, business and repair, real estate, public administration, and religion would reveal large differences in skill requirements of such jobs. So generalizations about such skill requirements should be made carefully.

Further, we most typically think of information age jobs as those associated with "high-tech" industries. But there is convincing evidence that while employment in "high-tech" industries is growing faster than average for industry growth, such jobs will now and in the future account for no more than 6%

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[2] Louv, pp. 215-219, and Bruce Nussbaum, The World After Oil, (New York, 1983), pp. 269-274.

[3] Louv, p. 217.

[4] Workforce 2000, (Hudson Institute, 1987), pp. 101-103.

[5] Michael Urquhart, "The Employment Shift to Services: Where did it Come From?" in Monthly Labor Review, (April, 1984), p. 16.

of the new jobs in the economy.[6] Such jobs as engineer, mathematical specialist, physical scientist, computer specialist, and engineering technician will require an in-depth knowledge of engineering, science and mathematical theories underlying new technologies, but such high-skill occupations will be limited in numbers.[7]

Other "high-tech" related jobs such as computer operators, computer service technicians, machine repairers, and users of computers will not require in-depth knowledge of such theories.[8] Job holders in these areas, however, will need to be skilled at diagnosing problems, following instructions and procedures, and manipulating information. Most jobs will require the use of computers, but the level of computer skills required will not be the most serious obstacle to qualifying for the jobs in question.[9] Such required skills may involve merely reading a terminal, entering data into a terminal, or printing data. Higher levels of skills such as choosing and using alternative software programs, using graphics for design, or writing programs will not be required for such jobs.

In fact, a key problem may be the fear and anxiety about the use of computers--perhaps through lack of early exposure to computers in schools--rather than being unable to satisfy appropriate computer skill requirements. On the other hand, there should be cautions taken regarding such early exposure. Roszack calls attention to the cultural tendency of interpreting all thinking on an information processing model of thinking--a model of shuffling data according to formal rules. That model, he suggests, neglects thinking which operates by "gestalts" and which forms hierarchies of projects, evaluating them in the context of cultural values. This latter model is most distinctively human thinking.[10] If the information model of thinking is used as the model of human thinking, then humans are implicitly being viewed in a way that makes them an inferior analogue of the computer. The reason is that this sort of computation is something that computers do better than humans. Thus young children need to be both acquainted with computers, but not to receive "subliminal" lessons that their way of thinking is a mere inferior analogue to computers.[11]

If urban minority youth lack qualifications for these new information age jobs, it will often be a result of specialized skill requirements other than computer skills. On one view, a key skill qualification for entry level positions in information age service jobs is an 8th grade level of basic skills--reading, writing, and math--and the requirements for such basic skills may increase to 12th grade levels. Similarly, the Workforce 2000 report indicates that the average education and skill level requirements will be higher for jobs in the future than is the case now. The report suggests that the median years of education for jobs will be 13.5 years as compared to the current 12.8 years.[12] So as computers become more "user-friendly" as manufacturers seek new markets for them, the overall education and skill requirements for the workforce will rise in basic skill areas, though not necessarily in computer skills. More important for preparation for work will be the increased emphasis on language, math, and reasoning skills.

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[6] Richard Riche et al, "High Technology today and tomorrow: A Small Slice of the Employment Pie," in Monthly Labor Review, (November, 1983), p. 54, and "High Tech is Low on Jobs," (Business Week) reprinted in Tom Forester ed.,The Information Technology Revolution, (Cambridge, 1985), pp. 390-400.

[7] Ibid., p. 54.

[8] Ibid.,p. 54.

[9] Joyce Slayton Mitchell, Your Job in the Computer Age, (New York, 1984), pp. 3-12.

[10] Theodore Roszak, The Cult of Information, (New York, 1986), pp. 213-216.

[11] Ibid., pp. 218-219.

It has been suggested that growth in jobs in the 1990's will be in low-skill, low earnings service jobs (54%), with top earnings level job growth second (35%), and middle earnings level jobs growing the least (11%).[13] But the Workforce 2000 report emphasizes that while there will be job growth in the low and medium skill categories, the overall trend is toward higher average skill requirements. The low-skill jobs may face replacement by computer-based technologies, as these jobs are more easily subject to automation.[14]

If work in the fast-food industry typifies the low-skill and low earnings character of these service jobs, then it is important to note that most managers of fast-food restaurants recruit management trainees from outside the staffs of their restaurants.[15] Further, 70% of the employees of fast food restaurants range in age from 16 to 20 year range, and higher percentages of blacks (16% from 12%) and lower percentages of whites (77% from 83%) now hold these positions as compared to the 1980 Census.[16] Finally, these jobs have shown little if any relation to schooling, and teach students very few skills.[17] If more black youth are taking jobs which have little mobility to higher skill level positions, and if no significant training is provided on these jobs, then the key questions are: how can urban minority youth gain a decent standard of living and how can they learn new skills appropriate to advancement in a polarized labor market which has little provision for further training of those on the bottom levels?

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[12] Conversation with David Lacey, President of Private Industry Council of Philadelphia, and Workforce 2000: Work and Workers for the 21st Century, (Hudson Institute, 1987), pp. 97-101.

[13] Eleanor Holmes Norton, "Minority workers of tomorrow must tread a different path than today's middle class," in Isaac Asimov et al eds., Work in the 21st Century, (Alexandria, 1984), pp. 70-71.

[14] Ibid., p. 99.

[15] Ivan Charner & Bryna Shore Fraser, "Fast Food Jobs: National Study of Fast Food Employment" (September, 1984).

[16] Ibid.,

[17] Ellen Greenberger & Laurence Steinburg, When Teenagers Work, (New York, 1986), pp. 63-67.

III. Post-Industrial Urban Geography

Cities surely are the centers of the most rapid changes in the industrial landscape. Deconcentration of populations is happening as out-migration of the wealthy to suburbs and exurbs is occurring rapidly, while the poor are left behind, thus leaving cities with a reduced tax base and increased need for public services. That, as David Clark suggests, is the central dilemma of cities in Urban America.[18]

Cities may be viewed as a series of geographical rings, with the core being the tall buildings of central business districts. These central business districts have been experiencing dramatic increases in office space, development of conference centers and hotels, and they remain the locus of exclusive retail shops and restaurants. Convenience services are also located here for the clientele of the central city. The value of land is high, and so vertical development makes possible the maximum intensity of use of the land.

Next, there is the fringe of old industrial and wholesale sections around the central business district. Light manufacturing, warehouse, and transport activities occur in this fringe as an integrated service to the central business district. The urban inner city areas are in the next ring(s), where old housing exists, property values have declined as out-migration of the wealthy brings middle and then low-income families. Following the decline in property values is the decline in available insurance and financing.[19] The economic system of the larger society in effect breaks down in inner city rings, and it is the residents of these rings who experience severe economic difficulties. Urban minority youth often come from these sections.

There has also been a migration of successful white-collar blacks to suburbs.[20] The evidence suggests that the bulk of economic progress among blacks is in this 22 percent suburban black population--as distinct from inner city and rural blacks. Suburban blacks, for example, recently experienced "a 91% rise in employment in professional fields, compared with a 16% increase among city residents.".[21]

Also, where low-skill jobs are moving to suburban areas faster than low-skill workers, and where Central Business Districts generate jobs requiring higher skills, low-skill workers must travel to suburbs in greater proportions to find work. Not unexpectedly, Ellwood found that young and low-skilled blacks spend more time traveling to work than do whites.[22] But Ellwood also found that most workers must travel beyond their neighborhood to work. The movement of low-skill jobs to the suburbs does not, then, explain the poor performance of inner city youth is. Even though there were dramatic differences in proximity to work of South and West side minority youth in Ellwood's study, there was little difference in the economic performance of the two groups.23

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[18] David Clark, Post-Industrial America, (New York, 1985), p. 142.

[19] Ibid., pp. 134-138.

[20] Diane Nilsen Westcott, "Blacks in the 1970's: Did they scale the job ladder?" in Monthly Labor Review, (June, 1982), pp. 33-34.

[21] Ibid., pp. 33-34.

[22] David T. Ellwood, "The Spatial Mismatch Hypothesis: Are Teenage Jobs Missing in the Ghetto?" in Freeman & Holzer eds., The Black Youth Employment Crisis, (National Bureau of Economic Research, 1986), p. 182.

The implication of his study is that the maximum limits of number of miles and time it takes to travel to work are much greater than has sometimes been assumed. To be sure, many inner city youth do not have cars, and so must rely on public transportation or rides from co-workers. And the cost of transportation becomes one of the many trade-offs concerning the choice of work. But the more important variables for employment opportunities remain the aggregate demand for workers, poverty, and education.24

Ellwood's findings do not invalidate the basic thesis concerning the exodus of blue collar work, but only shows that the distance and time limits of travel are more elastic than has been assumed. As available jobs move from suburb to exurb, the limits may eventually be reached. Where a person works does depend on the available transportation. Lacking the use of private autos, public transportation becomes particularly crucial--not merely a convenience--for the work opportunities of many minority youth, especially where such youth are often ghettoized by virtue of their lack of wealth or their race.

Ellwood's findings are ahistorical, but the geographical and economic situation of inner-city blacks can be understood only in the context of historic racism. As suggested by Wilson,25 one of the legacies of racism is the concentration of the black underclass in the inner city. Even without the current dramatic changes in the structure of employment in cities, blacks have experienced the difficulty of finding occupational niches within the city economy. And much of this has resulted from the mass migration of blacks from the rural south to northern inner city areas. To complicate this, the recent movement of the black middle class out of the inner city has resulted in a concentration of inner city poverty. As a result of the legacy of racism, those who have remained have been concentrated in just those industries which have been dislocated by the structural changes of the city economy. Black youth, therefore, find that they cannot follow in the occupational footsteps of their parents.

The low income status of those who experience employment difficulties and cutbacks in federal funds for job training ensured that they would have few resources to adjust to changes in their city environment. The fact that the unemployment rate of black youth has dropped from 52 percent to 29 percent in the past few years shows how their fate is inextricably tied to health of

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23Ibid., pp. 178-180.

24Jonathan S. Leonard, "Comment," in Freeman et al eds., pp.185-188.

25William Julius Wilson, The Truly Disadvantaged, (Chicago: The University of Chicago Press, 1987), pp. 33-62.

the mainstream economy. But because inner-city youth tend to be at the back of hiring queues, their fate is more sensitive to the health of the mainstream economy than with other groups. Hence, while geographical location is a factor in the employment difficulties of black inner-city youth, it is more accurate to suggest that the legacy of racism, economic disadvantage, the placement of black youth at the back of hiring queues, structural changes in city economies, and cutbacks in government support programs have combined to create these difficulties. This mix of long term, medium, and short term factors is what makes their plight especially difficult.

IV. Employment Dynamics of Black Youth

At this point it will be useful to look more closely at the the employment dynamics of inner city black youth to see how these fit into this larger picture.[26]

Ballen and Freeman describe these dynamics with the following as their central findings: First, while the rate of employment normally increases for youth as they age, the increase of the rate of employment is very attenuated for inner-city black youth. Those who experience the worst rate of increase of employment with age are inner city black youth who are high school drop outs. Because black youth drop out more often, the problem of joblessness is much less likely to disappear as inner city black youth grow older. Second, the differences of overall rates in employment are primarily attributable to the shorter spells of employment, longer spells of nonemployment, and the large fraction of inner-city black youth who are never employed.[27]

Ballen and Freemen also find that the principle difference between inner city black youth and other youth in transitions between nonemployment and employment is that these black youth more frequently experience difficulty in making this transition. Inquiries about the reasons suggest that employers interpreted spotty work records as indicating lack of interest in working, even though spotty work records may result from such factors as previous discrimination. The older the youth, the more likely employers are to conclude from a spotty work record that the youth lacks commitment to or interest in working. When asked, employers claimed that those with spotty work records had frequent absenteeism and turnover. So as inner city black youth experience periods of nonemployment and as they get older, they will tend to be screened out by employers, and if they work, they tend to be caught in recurring patterns of short-term jobs such as seasonal employment.[28]

On the other hand, for those inner city youth who are employed, there is less difference between their transition probabilities between employment and nonemployment as compared with other youth.[29] In general, both black and white youth have less chance of becoming unemployed the longer they have been employed.[30] As they age, however, most inner city black youth who have worked remained in low skill level occupations, with "flat age-earnings profiles: a bare 5 percent were professionals or managers and just over 15 percent were in any white collar job, whereas some 40 percent were in laborer or service jobs."[31] As for inner-city Puerto Ricans, a recent study by the National Commission on Secondary Education for Hispanics indicated that, in 1984, almost 30% worked as operatives (including transport), 19.1% as clerical, and 18.6% as service workers. Only 8.4% worked in professional and technical fields and 3.7% were managers and administrators. Very few inner city youth work in jobs which require considerable education or on-the-job training. As a result, inner-city youth do not necessarily reduce their chances of nonemployment the longer their duration of employment. At least in part, the reason seems to be that they do not want careers in dead end jobs, though that is the kind of jobs they receive.[32] The fact that inner city youth often do not have significant opportunities for on-the-job training experiences or education makes them less likely to obtain valuable skills which would lessen their chances of nonemployment in the future.

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[26] John Ballen & Richard Freeman, "Transitions Between Employment and Nonemployment," in The Black Youth Employment Crisis, pp. 75-99.

[27] Ibid., p. 98.

[28] Ibid., p. 93.

Put in a larger perspective, these employment difficulties reflect the lack of opportunity of inner city black youth to move into career employment. Their reactions to this ceiling of opportunity tends to get interpreted by employers as evidence of their lack of a work ethic. On the other hand, inspite of these problems, some of this group do move into career employment.

V. Aspirations and the Work Ethic: An Explanation?

One may ask whether inner city black youth lack an appropriate work ethic, and whether that explains the employment dynamics described above? Findings concerning "reservation wages" bear on this question.

Holzer found that in an "absolute" sense reservation wages ("the lowest wages individuals are willing to accept for employment."[33]) are comparable for young blacks and whites, but that reservation wages for young blacks are higher after controlling for wages and weeks worked.[34] The implication is that young blacks model their aspirations and expectations after the mainstream society, but have fewer effective means of achieving these aspirations.[35] If so, then the "culture of poverty" view that inner-city youth simply lack such aspirations is not correct. Rather, the research points to the lack of "effective means" for achieving those aspirations.

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[29] Ibid., p. 99.
[30] Ibid., p. 99.
[31] Ibid., p. 95.
[32] Ibid., p. 99.
[33] Ibid., p. 23
[34] Harry J. Holzer, "Black Youth Nonemployment: Duration and Job Search," in The Black Youth Employment Crisis, p. 51.
[35] Ibid., p. 65.

Holzer's study implies that creating dead-end jobs for such youth will at best have temporary value, since while black youth are willing to accept such jobs, they are only willing to do so when they see them as temporary. When they consider the prospect of having such jobs for a lifetime, they understandably are no longer willing to accept them.36 Public policies which aim to solve their employment difficulties through creating such jobs are likely to be at best temporary expedients, and not long term solutions.

Sowell, however, questions the validity of such methods of determining aspirations. He says,

> Many attitude surveys have concluded that low-achieving groups have the same values or aspirations as high-achieving groups, but answering survey questions costs little effort while economic advancement may cost years of sacrifice and hard work. What is relevant is the willingness to pay a price to achieve goals. Large behavioral differences suggest that the trade-off of competing desires vary enormously among American ethnic groups.37

On Sowell's view, the legacy of slavery exacerbates these problems. While other minority groups have used menial jobs as a means to eventual labor market success, inner city black youth reject this strategy. He says that, historically speaking, slaves and slavemasters learned to disdain menial work, viewing it as the sort of work individuals would have to be coerced into doing. Sowell suggests that the legacy of slavery has created an anti-work ethic which handicaps blacks who resist "the inherent requirements and constraints of labor markets" and who are preoccupied with the status aspects of work.38

Even if black inner city youth reject certain jobs as status insults, however, it is not clear whether this is from the legacy of slavery or merely from a sense of pride and self-respect. Also, as a matter of fact, the Father Divine movement did follow something like the strategy of utilizing menial jobs to escape conditions of poverty. Father Divine got participants to pool resources, reduce living costs through communal living arrangements, and take on menial jobs as part of a collective economic effort.39 So the strategy described by Sowell has not been a complete stranger to black inner city residents.

There is evidence that the "culture" of inner city youth makes a difference, since, churchgoing, for example, results in substantially different behavior among these youth, including habits which improve chances of escape from inner city poverty

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36Ibid., p. 65.

37Thomas Sowell, The Economics and Politics of Race, (New York, 1983), p. 194.

38Sowell, pp. 123-125 & 141.

39See William M. Kephart, Extraordinary Groups, (New York: St. Martin's Press, 1987), pp. 93-142.

status. Possibly, churchgoing offers a vision of life which creates optimism where otherwise there might be despair.

Further, the experience of a member of the family working also improves chances of escape.[40] In fact, one key factor in the success of the "new" black middle class is the "striving families" of those who were successful. These were families in which mother and father worked and which made many sacrifices to facilitate the success of their children.[41] Also, according to Freeman's study, those inner city youth who are registered voters are more likely to be good workers. For these individuals, the "culture" inculcates habits of allocation of time, school attendance, work activity, and resistance to participation in socially deviant behavior. These habits contribute significantly to the movement from poverty to affluence. Working hard, working long, and saving one's money, according to one author, are more significant for labor market success than developing specific job skills.

These studies do suggest that "culture" which includes a strong work ethic has some impact on labor market success. But it remains to be seen how the unique religious beliefs and leadership which make this possible could be replicated on a mass basis. While the Father Divine movement worked for some individuals, it may have too many unique features which could not be generalized to large segements of inner city populations. There is a greater chance of replication with the established religions in the inner city black communities, but even these will not likely reach all inner city residents. And it would be wrong to propose that belonging to such movements is obligatory for inner city residents who experience employment problems.

Sowell assumes that situation of inner city black youth and other ethnic groups are similar. As Wilson has pointed out, however, the employment structure of the cities, migratory patterns, the health of the economy, the sheer magnitude of youth who need an occupational niche, social organization, and historic racism may combine to make it extraordinarily difficult for inner city black youth to achieve career employment. In some of these respects the situation of black inner city residents may be different from some other ethnic minorities. Even very motivated youth will encounter insurmountable problems in achieving the career employment they aspire to have. Their social isolation from opportunities for real labor market success may be too great to expect success on a mass basis.[42]

It should be mentioned that Hispanic youth face a similar situation. As a consequence of economic need, they tend to drop out and accept full time jobs, but according to the National Commission on Secondary Education for Hispanics, accepting these jobs excludes them de facto from pursuing better employment opportunities as well as higher education. This is further evidence of how impoverished economic status can prevent mobility in career employment.

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[40] Richard B. Freeman, "Who Escapes? The Relation of Churchgoing and other Background Factors to the Socioeconomic Performance of Black Male Youth from Inner-City Poverty Tracts," The Black Youth Employment Crisis, pp. 353-374.

[41] Bart Landry, The New Black Middle Class, (California: The University of California Press, 1987), pp. 95-99.

[42] Douglas Glasgow, "The Black Underclass in Perspective," in The State of Black America, (Urban League, 1987), pp. 131-134, and Wilson, p. 57.

One study suggests that welfare has an adverse impact on work performance. The study points out that inner city black youth in families with welfare status had significantly poorer school and work performance. They were much more likely to be neither working nor in school.[43] The author and commentators raise question about the complex interactive effects of welfare status, school performance, and eventual work performance.[44] The question is whether welfare causes difficulties in adjusting to employment or whether it is merely symptomatic of the employment problems of the most demoralized groups in inner city neighborhoods. It is at least plausible to suggest that families on welfare tend to be demoralized through the lack of concretized experience of employment, the lack of networks which connect them with career employment opportunities, the lack of training and monetary resources to prepare them for employment, and racist ceilings on employment opportunities. The lack of such "effective means" for achieving career employment could be experienced most accutely by those who have to resort to the indignities of the welfare system for support.

Evidence for this sort of attitude is given by Piore. He agrees that inner city black youth are weakly attached to menial jobs because they fear they will be permanently stuck in such jobs. But those youth who believe they will move on to higher level jobs in a mobile career pattern are likely to develop a stronger attachment to their jobs.[45] Hence, if there is a lack of sacrifice, discipline, and hard work of inner city youth who have mainstream aspirations, then it may reflect their reasonable belief--based on what they observe in their neihborhoods and among their peers that regardless of how hard they work they still lack real career opportunities. Making sacrifices, putting forth effort, and discipline makes sense within their frame of reference only if they have a realistic belief that this will pay off. So far as they can see, it does not pay off.

Unfortunately, because of their separation from mainstream economic activity in their daily existence, there is little opportunity for such a belief to be confirmed by experiential realities. Wilson and Louv underscore this point. On Louv's account, the parents of these youth often work in America I occupations which are declining and the new jobs in cities are predominantly America II type jobs. But America II social organization has insulated itself from the inner city and from the inner city youth who might benefit from greater familiarity with American II. Given the current situation, they do not get that. On Wilson's account, the pattern of dead-end jobs available to inner city youth and the lack of community norms which emphasizes work are part of their isolation from the mainstream. Their social isolation is the problem, not that they lack the aspirations for success in career employment.

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[43] Robert Lerman, "Do Welfare Programs Affect the Schooling and Work Patterns of Young Black Men?" in The Black Youth Employment Crisis, p. 436

[44] Samuel L. Myers, "Comment," pp. 438-439.

[45] Michael J. Piore, "Comment," in The Black Youth Employment Crisis, pp. 399-401.

Those families which do find effective means of escaping the poverty of the inner city also tend to be the families whose success permits them to leave the inner city. Wilson suggests that inner city poverty is becoming more concentrated because of this phenomenon. Those successful blacks who might provide experiential confirmation of the prospect of labor market success are tending to leave the inner city. Those who have employment difficulties and provide experiential confirmation of the difficulty of labor market success remain behind. To the extent that this happens, opportunities for learning habits which lead to labor market success in career employment will be lacking in inner city areas. And in a fundamental way, the opportunities to receive an optimistic vision of an upwardly mobile career will tend to be evanescent.

VI. The Role of Employers.

Since by definition employers provide employment opportunities, and since most employers are unlikely to be from inner city areas and unlikely to be black, there are differences between employers and inner city youth which can easily lead to misunderstanding. Employers are in business to make a profit, and they need employees who will assist them in making that profit. So it is a reasonable expectation that the prospective employee demonstrate his or her capacity to assist the employer to make a profit, or to solve the problems the employer hires him or her for.

A hurdle faced by the inner-city youth is to show the employer that he or she can do the job. But there are additional hurdles an urban minority youth must overcome which other youth may not. Racism, of course, is a central one. In one study black and white high school youth were sent to employers to interview them. Black youth were treated with less courtesy, were not as often addressed as "Mr." or "Ms.," were not as often informed of job prospects, and were not as often asked to be seated. With race discounted, however, the black and white youth were equally desirable as employees. Also, the study found that employers in retail establishments discriminated against black youth in this respect more than did employers in manufacturing.[46] This is significant because the available manufacturing jobs for inner city youth are diminishing. Another study suggested that some of the reasons why black youth tend to be at the rear of the hiring queue are that employers perceive them as being less dependable, and there is evidence to suggest that black youth are more likely to be absent from work than white youth.47

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[46] Jerome Culp & Bruce H. Dunson, "Brothers of a Different Color: A Preliminary Look at Employer Treatment of White and Black Youth," in The Black Youth Employment Crisis, pp. 250-251.

There is a complex relationship between employers and black youth employees. Employers treat black applicants with greater disrespect, including putting them at the back of the hiring queue. Black applicants perceive this as racist, responding with dissenting behavior such as absenteeism. Further, minority youth tend to get dead-end or menial jobs, and are thus more likely to be absent because such jobs are a status insult, teach fewer skills, and are less valuable as credentials. Within the framework of such positions, the response of such youth is rational,48 but employers interpret this as indicating a weak commitment to work; they see black youth as being less likely to solve employer problems related to the generation of profit. The end result is more likely a quit or discharge, since the employer-employee relationship misfires.

The findings of this project are congruent with what many black youth know to be employer attitudes to them. It is no wonder that inner city black youth do not feel like they get a fair opportunity to compete for jobs. Even if the structural problems of the city were nonexistent, this lack of understanding and misperception would still be significant for the employment prospects of inner city black youth.

VII. Demographic Impacts of Women

In labor markets there is a distinction between those groups which are complementary and those which are competitive for jobs. Those who are competitive are those whose labor could "substitute" for the labor of others. They compete for the same jobs, while those who are complementary do not compete for the same jobs. Borjas has found that while other immigrant groups are complementary to black groups, women are competitive for manufacturing jobs. His suggestion is that the rapid rise of women in the labor force has been a significant factor in the reduction of labor market opportunities for black youth, especially black male youth. If the trend continues, such youth would experience a decline of 4 to 10 percent in wage relative to the white male wage.49 Inner city black youth, then, are in the back of the hiring queue behind other groups which experience discrimination.

Another study is interesting in this respect. In analyzing the shift to a service economy, Urquhart inquired about the sources of new employees. He discovered that the unique feature of the service sector is that new employees were more often those who had not previously worked (6 to 1) and were women. So he

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47Ronald Ferguson & Randal Filer, "Do Better Jobs Make Better Workers? Absenteeism from Work Among Inner City Youths," in The Black Youth Employment Crisis, pp. 261-262.

48Ibid., p. 292.

49George Borjas, "The Demographic Determinants of the Demand for Black Labor," The Black Youth Employment Crisis, pp. 192 & 203-208.

concludes that the shift of employment to services did not result in the shift of workers from one sector to another of the economy but resulted from the expansion of the labor force especially in the area of services.50 Women as a group appear to more easily move into the mainstream economy than inner city black youth. Possibly, this is because they have experienced many of the family and educational advantages of white men, whereas inner city minority youth have not.

VIII. Underground and Alternative Economies.

If we are to consider how schools ought to prepare inner city black youth for work, then we need to have some vision of their career options. Most unfortunately, gang and drug activities can become an alternative to career employment in the mainstream. Charles Handy pegs the level of underground economic activity in the United States at 14 percent of the GNP. Much of that activity is surely underground economic activity related to drug trade. Even as inner city black youth pursue schooling, this underground economic activity provides a perpetual temptation to them. Inner city schools are faced with a perpetual battle with the gang and drug culture to win the hearts of inner city youth. Without a vision of legitimate economic alternatives the drug and gang culture is likely to win that battle. The following is a sketch of a legitimate alternative to the economic activities associated with illegal drugs. It is intended, however, as a conceptual alternative rather than the development of a full blown vision.

On this view, inner city economies might be transformed from crime dominated activities to viable enterprises through generation of "alternative worlds of work." This strategy is prompted by the lack of good mainstream job opportunities for inner city youth, and the fact that many would rather not work in the mainstream because of insensitivities and racism of many mainstream employers. Hence, the idea is to emphasize the development of the black economy in the inner city as an alternative to mainstream options. A viable inner city economy would give black youth increased alternatives of career employment. Much as other ethnic groups have formed alternative and distinctive economies within large cities, this vision is of an alternative and flourishing black economy in inner city neighborhoods.

Another suggestive way of looking at the situation is made by Charles Handy. He says that British workers may face a future without sufficient numbers of good jobs. In this situation it is strategically important to stress that joblessness does not entail worklessness, since there is an unlimited amount of work that needs to be done. People must have work because everyone needs to think they matter to others, and everyone needs to have hope that they will have a decent economic future.51 The sense of community is thus very much connected with having work to do.

50Michael Urquhart, "The Employment Shift to Services: Where Did It Come From?" Monthly Labor Review, (April, 1984), p. 20

51Charles Handy, The Future of Work, (London, 1984), p. 38.

Inner city black youth are no exceptions. Given the mass joblessness they now face, they also need to think that they may have a decent economic future. Handy's proposal is that those facing joblessness must recognize that jobs are not exhaustive of all work, and that there is much work to do even without a job. Finally, in this area of "marginal" work which is not job-work, there is the possibility of invention of new forms of remunerative work. The idea is to keep alive the entreprenurial spirit and tradition even when there is mass joblessness. If a jobless person keeps working, then that both provides a source of hope for a better future and a community building alternative to illicit economic activities within inner city neighborhoods.52

Not every inner city black youth will find such an alternative attractive, but if for some this provides an alternative to illicit economic activity, then it serves an important purpose. Further, it is an economic vision which emphasizes that the inner city resident take control over their own future through their own work. And if some entrepreneurial enterprises get generated through from such a vision, then it is possible that success will be spread through informal cultural channels within the inner city. Indeed, such a vision would become real if inner city black youth could see that others who are similar to them find alternative work through entrepreneurial initiative.

The experience of immigrant groups provides an example of an alternative world of work. Chinese restaurants, for example, are not something which would likely be created by Anglo-saxon entrepreneurs. But they are naturals for Chinese immigrants because they are part of Chinese-American culture. Likewise, rib restaurants and take-out stands are a product of black culture. Because residents often know the tastes of members of their own culture better than outsiders, they will be able to cater to those tastes in a way that is economically competitive. More of such "inventions" could be generated within the subculture of the inner city. Finally, public policy might support such activities by providing entrepreneurial business training and support, by removing blocks which prevent an inner city economy from flourishing, and by spreading the understanding of successful enterprises to other inner city residents.

The invention of new technologies which extend the productive capacity of workers is important as components of these new worlds of work. Schumacher thinks that there is a need to develop "intermediate" technologies which serve the human needs of people. These criteria of these technologies include that they be superior to primitive technologies, but are simpler and cheaper than the supertechnologies of the rich.53 While "high-tech" as an entrepreurial alternative may seem out of reach for many inner city youth, it may be possible to put these intermediate technologies and associated forms of work within their grasp.

52Charles Handy, The Future of Work, (Oxford, 1984), pp. 52-57 & 188.

53E.F. Schumacher, Small is Beautiful, (New York, 1973), pp. 153-154.

Public policy may provide assistance. Given that there is choice about where to allocate resources in the advance of technology, development of technologies congruous with and tailored to improving inner city life might go a long way toward establishing a viable inner city economy.

Unfortunately, the illicit alternatives within the inner city are very troublesome developments. Because of the harm that they do both to individuals and the inner-city community, many inner city residents are distressed by such activities. In one study, when asked about the extent of criminal behavior they had engaged in, inner city youth indicated that approximately 25 percent of their income came from crime related activities. But only one-fifth of those who engaged in criminal activities were considered to be "hard core" criminals. The study also concluded that economic incentives for crime are significant, and that alternative "carrots" (such as other sources of income) would be more effective in reducing crime than "stick" approaches.54 Other authors have criticized these findings. They hold that criminal activity among inner city youth is more widespread, as indicated by the fact that nearly 51 percent of black males will be arrested for a felony charge by their mid-twenties, and that 40 percent will mix legal employment activities with criminal activities.55 While we do not know the exact extent of criminal activity, it is not surprising that it is so widespread. But if legitimate alternative worlds of work in inner city areas became realistic, then those inner city youth who are not hard core criminals may find the alternatives attractive.56

One reason why blacks have traditionally wished to "escape" from the ghetto is that there is insufficient legal economic opportunity in ghettoes and too much crime. With crime rates high, the cost of doing business in such areas is also high, and so the price to ghetto residents will be high.57 It is crucial, therefore, for inner city neighborhoods to win the battle against criminal activities. At the same time, however, that battle will be easier to win if many inner city black youth are given legitimate alternatives within the inner city. Hence, this proposal is for schools to play a role in cultivating entrepreneurial traditions which suggest alternatives within the grasp of inner city residents. Criminal activities must be curtailed, but something needs to take their place, and such an alternative inner-city black economy is one possibility.

IX. Mainstream Alternatives

Inner city black youth--especially the most disadvantaged among them--have received very little benefit from affirmative

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54W. Kip Viscusi, "Market Incentives for Criminal Behavior," in The Black Youth Employment Crisis, pp. 336 & 343.

55James W. Thompson & James Cataldo, "Comment," in The Black Youth Employment Crisis, pp. 347-351.

56Sowell, p. 203.

57Thomas Sowell, Race and Economics, (New York, 1975), pp. 159-178.

action programs designed to eliminate employment discrimination. Such programs have tended to benefit those more advantaged minority group members.58 This has created a schism between middle class and poor blacks. As middle class blacks improve their life circumstances, they tend to move to middle class locations, leaving behind the poor blacks who most need assistance. Public policy has contributed to this schism by concentrating on affirmation action. Also, programs targeted for the black underclass have difficulty gaining political support, especially in hard economic times. A key problem for CETA was that when it was perceived by employers as a program for blacks, many pulled out, thus leaving agencies responsible for job training.59 When that happened, a key to the success of the program had been lost.

Wilson proposes that programs which intend to improve the life chances of the ghetto underclass ought to be universal. They ought to be applied across class and racial/ethnic lines.60 The ghetto underclass might then be beneficiaries of such programs, while at the same time such programs would have broad appeal to the public. One such program might begin with the guarantee that a young person have a significant learning opportunity in the world of work. Such a program might endorse the current emphasis on government and business partnerships. Government needs to create an incentive structure for such a program, and the incentive structure must be attractive enough to entice reluctant firms to hire young persons. But such a program ought to be constructed on a national basis and should be aimed at creating large numbers of trainee positions in society's employment institutions. Participants would then receive a combination of training plus experience. For most trainees it would be viewed as an entry point to regular positions within the employment organization. Schools would provide supervision and coordination for their students, and auxiliary training and educational programs would be provided for special needs of special groups, including inner city black youth. The objective of this is to provide an entry point to the mainstream. The idea of partnerships is to encourage those institutions to do what they do best in preparing youth for work.

As suggested by Marland, schools should facilitate career awareness, self-awareness, economic awareness, basic skills, employability habits and skills, and the understanding of the relation of education and the world of work.61 At this point, we need to review what has actually happened regarding the school to work transition of inner city black youth.

58Wilson, pp. 112-118

59David Bresnick, YouthJobs, (Connecticut: Quorum Books, 1984), pp. 29-47.

60Wilson, pp. 120-124

61Sydney Marland, Career Education: A Proposal for Reform, (New York: McGraw-Hill Co., 1974), pp. 101-106.

X. Relationships of School related factors and Labor Market Success

The findings of one early study suggests that traditional measures of academic success (class rank and performance on standardized tests) are positively related to rates of employment and wages in early labor force experiences of all students. The studies suggest that general academic preparation and hours worked in high school are positively correlated with later success in labor markets.62 Secondly, the authors found that work experience while in school was significantly correlated with later labor market success. But the work experience in low-level dead end jobs did not hinder later success.63

On the other hand, vocational training directed toward job-related tasks did not correlate significantly with successful performance in labor markets. While one might think that high school training aimed directly at positions in industry would be the most significant, its lack of success suggests there is something seriously wrong with this mode of preparing students for work. Also, the explanation of the failure of this approach is not that the type of students taking such studies are especially dull students, since the results were controlled for class rank.64 By contrast, on-the-job training after school was positively associated with higher wage rates.65

What differences exist between blacks and whites concerning these factors? Grant's findings are especially striking for black dropouts. While the labor force participation rate for white graduates and white dropouts move closer together as the population ages, this does not occur for young black dropouts and graduates. For black dropouts there is little net aggregate movement into the labor force.66 This would suggest that blacks who drop out of school face a very different set of dynamics, including a more pervasive alienation from a white dominated school and employment system. On the other hand, black youth--like white youth--experience significantly positive correlations between high school degree status, high school achievement, and work while in high school with labor force participation rates.67

One other difference of black youth and white youth is that while there is no significant correlation between vocational training in or after secondary school and labor force participation and wages, vocational training improves the

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62Robert H. Meyer & David A. Wise, "High School Preparation and Early Labor Force Experience," in Freeman & Wise eds., The Youth Labor Market Problem: Its Nature, Causes, and Consequences, (National Bureau of Economic Research, 1982), p. 329.

63Ibid., p. 329.

64Ibid., p. 307.

65Ibid., p. 328.

66Jim Grant, "Education, Training, and Labor Market Performance of Youths out of School," (unpublished, 1983), p. 7.

67Grant, p. 8.

employment probabilities of inner city black youth.[68] But this positive finding should be seen in the light of the the disadvantages of vocational training in high schools, for such programs must prepare students in job specific skills for different workplaces, and for job specific skills in workplaces which are themselves being rapidly changed by new technologies.[69] Also, ensuring that teachers are up to date on all of these changes is itself a monumental task, since teachers do not have sufficient opportunities to update their own skills.[70] So vocational education is particularly vulnerable to offering obsolete training for the world of work, while costs are too great to provide facilities and human resources which are current with the changing workplace.[71] If vocational training does have positive impacts for the labor market prospect of minority youth, some further research should seek to uncover the reasons.

Vocational training should include cooperation with participating employment institutions. Students would then have on-the-job-training opportunities as part of their vocational training. This, it should be noted, is what both the Germans and Japanese do rather successfully, and is thought to be one reason why they have competed well in world markets.[72]

XI. Work While in School

The assumption that youth employment sets the stage for occupational advancement later in life is no longer valid. If we distinguish between the primary labor market composed of long term jobs with reasonable opportunities for promotion and advancement, and the secondary labor market which is composed of dead-end and temporary jobs with little or no opportunity for career advancement and low levels of pay, then the latter are the sorts of jobs which 16 to 19 year olds occupy while they are in school.[73] For many inner city black youth, these sorts of jobs are the only option available. Hence, it is particularly important to ask what impact these jobs have on the career prospects of youth while in school.

Employers and employer organizations have advocated through the Council on Vocational Education that high schools provide training in generalist skills of written and oral communication, analytical and problem-solving skills, computational skills, knowledge of society and one's role in it, and interpersonal skills, rather than job-specific vocational training. They argue that such skills are important to success in the world of work, and training in such skills lacks the problems of training in job-specific skill areas, since such skills are appropriate to changing patterns of work and appropriate to very different applications. When questioned about their requirements, employers

[68] Ibid., p. 41-42.
[69] David Bresnick, Youthjobs, (Westport, 1984), pp. 24-25 & 105.
[70] Ibid., p. 24.
[71] Ibid. p. 24.
[72] Ibid., pp. 61-79.
[73] Bresnick, p. 7-9.

CONCLUSION

The overall message of these recommendations is that where work is a complicated and problematic part of the lives of urban minority youth, STS modules should seek in a variety of ways to contribute to meliorating the minority youth employment crisis. Teachers should not attempt to substitute STS approaches for a comprehensive career preparation program. But the very nature of STS as an approach to society should, with minor modifications, contribute to the student's understanding of career options. Technology is so interrelated with jobs that in learning about issues concerning science, technology, and society, a student will be in a position to learn about associated jobs. Teachers can indeed do much to meliorate the employment crisis of inner-city youth, often by doing what they do best, by assisting students to learn about their world and to learn the general skills necessary for later specific learning concerning the job world.

expressed distress at the lack of generalist skills among individuals entering in the youth labor markets.74 But employers in the United States do not consider it worthwhile to invest in training in youth, preferring rather to train those in their mid-twenties who typically have completed college programs.75 This leaves the inner city minority youth who is not pursuing a college degree or not completing high school with the prospect of no job or forever bouncing around in the secondary labor market.76

The secondary labor market has advantages for those still in school, since it is part time work with odd hours, temporary, and provides income which they often spend on "luxuries."77 But the nature of these jobs do not demand the use of general educational skills. Opportunities to use such skills are estimated to be less than 10 percent of the student's time on the job.78 Also, there is a low incidence of job training that occurs in first jobs.79 If anything, students do learn some interpersonal skills and though understanding role relationships.80 On the other hand, such jobs do not deter deviant behavior, and may encourage money related deviant behavior such as use of drugs,81 and pocketing money from cash registers.82 Nor does such work lead to the accumulation of savings, though it does lead to cynicism about productive work.83 Without interpretative experiences in schools, these early work experiences may undermine important work ethic values, and optimism for the future.

Finally, the intensity of such work (more than 20 hours a week for seniors and more than 15 hours a week for sophomores) may have adverse impacts on schooling, since too high an intensity can dominate the time of the student, thus decreasing time spent on homework. Working too intensely in such jobs confirms the lowered expectations of the educational process for teachers and students, since it may lead to lowering of demands for performance in the classroom. The worst case is the potential drop out whose too intense involvement in such work pulls him or her away from school.84

XII. Schoolwork itself as a Kind of Work.

The discussion thus far has focussed on employment, but students also work as students, doing homework and participating in the activities connected with learning in the classroom. According to Carnoy and Levin, the school embodies within itself

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74Bresnick, p. 26
75Ibid., p. 8.
76Ibid., p.9.
77Ellen Greenberger & Laurence Steinberg, When Teenagers Work, (New York, 1986), pp. 60-65.
78Ibid.,p.66.
79Ibid., p. 107-109.
80Ibid., pp. 111-115.
81Ibid., p. 135.
82Ibid., p. 146.
83Ibid., pp. 142-143 & 29-30.
84Ibid., p. 152-155.

the tensions between reproduction of the class distinctions of workers on the one hand, and the expansion of democratic rights on the other.[85] As for the issue of reproduction, schools tend to reproduce work habits, attitudes, and expectations according to social class origins.[86] In a comparison of two schools, an upper-middle-class school and a lower-middle-class school, several differences were found in the practice of teachers regarding the reproduction of work expectations and habits.

"Upper-class" jobs are assumed to have several dimensions of values which differ from values of "lower-class" jobs. First, they have internal rather than external standards of authority. Second, they have a future rather than a present orientation. Third, they emphasize verbal self-presentation skills and cognitive skills and achievement. Carnoy and Levin report that in schools teachers treat students in ways that facilitate the development of values along these dimensions. As might be expected, the teachers in the upper-middle class school make more future oriented remarks regarding the student's future role, controlled students more by internal standards, emphasized open-ended verbal self-presentations, and made the development of cognitive skills a central focus of classroom activity. The opposite was the case of the lower-middle class school.[87]

An important question, then, is whether inner city schools reproduce the differential work performances of minority youth through the way in which the schools, the teachers, and others treat minority youth. If, for example, lowered expectations is characteristic of such schools, then does that not also convey to the students that less productive work in the future is expected from them? And if schools omit consideration of black cultural history and issues does that tend to convey the disrespect for such matters? Could racial codes be reproduced in such subtle ways?

Conclusion

Urban areas are some of the most rapidly changing of our post-industrial economy. While manufacturing jobs are moving from the central city to the suburbs and exurbs, office and service jobs are now coming to dominant the central cities. Urban minority youth thus face bewildering and rapid changes in those labor markets located near their inner city environment. To add to this, the skill level requirements of jobs will rise in the future, while with other dead-end jobs, it will remain low. Minority youth who are unsuccessful in development of high levels of skills in reasoning, computation, writing, and oral self-presentation will face the prospect of jobs in the secondary labor market or no jobs at all.

As they encounter the reality of such prospects, urban minority youth develop weak attachments to menial jobs, with

[85] Martin Carnoy & Henry M. Levin, Schooling and Work in the Democratic State, (Stanford, 1985), p. 110.

[86] Ibid., p. 112.

[87] Ibid., pp. 116-143.

attitudes which are exacerbated by the legacy of slavery. But employers treat such youth with less respect than others, and interpret their more spotty work records as indications of a lack of dependability. To further complicate matters, with the strong influx of women workers in the economy, there is much competition for urban minority youth. In an undetermined percent crime becomes an economic alternative, and hence it is crucial to provide legitimate and attractive alternatives for minority youth. Some of these alternatives may involve facilitating the capacity of minority youth to create new worlds of work, or to participate in new worlds of work.

Schools and churches become key elements in the escape of minority youth from this trap, with churches especially helpful in fostering an operative work ethic. Schools are most successful if they are able to encourage minority youth to complete their degrees, and achieve at higher levels. Where they fail in these ways, the youth have very poor employment prospects. Further, civic involvement is important, including becoming politically active in voting. This also correlates well with labor market success.

The minority youth employment crisis is complicated, and so should the range of responses. No one solution is likely to work by itself. But STS education can provide an opportunity for response through the infusion of lessons and units which facilitate skill development and understanding, impacts of technology on employment prospects, and alternatives understandable within an STS framework. An STS emphasis on technology and work can play an important role in having a positive impact on these problems.

Guidelines for STS Education Concerning Employment Difficulties of Inner-City Youth

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While a primary point of STS education is concerned with responsible citizen action in a technology and science dominated society, our discussion of the employment difficulties of inner-city youth shows the necessity of linking STS education and work. The following guidelines are addressed to this latter concern:

PART I: RECOMMENDATIONS FOR THE EDUCATIONAL PROCESS.

1. THE LEARNING PROCESS SHOULD EMPHASIZE ACTIVITIES WHICH DEVELOP TRANSFERABLE SKILLS.

A. THE LEARNING PROCESS SHOULD EMPHASIZE PROBLEM SOLVING SKILLS CONCERNING IMPACTS OF SCIENCE AND TECHNOLOGY ON EMPLOYMENT. STS themes include major social issues such as population growth, world hunger, air quality, war technology, energy shortages, land use, disease, hazardous substances, and the robot revolution. A course problem may be posed which requires that students define the problem narrowly enough so that it is actionable, gather information about it and diagnose its causes, formulate and assess relevant value issues, specify alternative solutions and plans, evaluate the alternatives, and engage in some appropriate action. Because of the complex and interdisciplinary nature of STS issues, solving problems in this area should develop skills which are transferable to employment contexts.

B. THE LEARNING PROCESS SHOULD EMPHASIZE COLLABORATIVE ACTIVITIES AMONG STUDENTS, AND THE DEVELOPMENT OF INTERPERSONAL SKILLS.

Pooling human and other resources is a very important ingredient in dealing with employment questions, which people often approach individually. So students should have the experience of using combined resources and information to solve problems. It is very likely that group support and problem-solving efforts will add to the ability of minority youth to meliorate employment difficulties. Especially important are the interpersonal skills developed in group problem solving activities, including skills in communicating, taking and giving instructions, empathizing with and understanding what others are thinking and feeling, leadership, and negotiation.[1]

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[1] David Johnson & Frank Johnson, Joining Together, (New York, 1982), pp. 401-420.

C. THE LEARNING PROCESS SHOULD FACILITATE THE DEVELOPMENT OF INVESTIGATIVE SKILLS.

Students should opportunities to learn how to observe, make applied math computations, compare and contrast, gather information, and find out how machines and tools work.

An example would be a post-industrial urban geography project which involves students in identification of where and what types of jobs there are in urban rings. Students may do calculations of the number of available employment locations within a specified number of miles and distance of travel. They may also develop ratios of manufacturing and service jobs. They may record observations at worksites of the people that worked there, what people told them about what they do for work, and of their reactions to employers they interview. Given the crisis nature of minority youth employment, such a post-industrial unit ought to be mandatory.

D. LESSONS AND UNITS SHOULD PROVIDE OPPORTUNITIES FOR STUDENTS TO INTERVIEW EMPLOYERS.

In a post-industrial urban geography project, for example, students may be asked to interview employers concerning the nature of the employer's business, and the technologies of production the employer uses. They may also ask what new technologies the employer expects to use in the next five years.

E. LESSONS AND UNITS SHOULD INSTRUCT STUDENTS IN THE SCIENTIFIC METHOD AND OPPORTUNITIES FOR ITS ON NONSCIENCE AND EVERYDAY PROBLEMS.

Scientific methods of experiment and observation could then be seen as useful both for finding out what uniformities there are in the natural world, and for finding out what patterns there are in work related situations. For example, they may use such methods to approach problems of why they are or are not getting hired, or they may use such methods to solve problems on the job.

F. LESSONS AND UNITS SHOULD DEVELOP SKILLS WHICH FACILITATE ADJUSTMENT TO RAPID CHANGE IN THE LABOR MARKET, AND WHICH ENABLE STUDENTS TO COMPETE FOR ENTRY POSITIONS IN HIGHER LEVEL JOBS.

It is especially important the students develop a habit and skills oriented toward the changing nature of work. Basic skills in writing, reading, and computation are important, and so are entrepreneurial skills and creativity.[2] A students who learns basic math concepts, for example, will have an easier time with new applications than one who has never had such exposure.

2. LESSONS AND UNITS SHOULD EMPHASIZE WORK ETHIC VALUES AND HABITS, AS THESE RELATE TO LABOR MARKET SUCCESS.

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[2] Peter Drucker, Innovation and Entrepreneurship, (New York, 1985), pp. 1-17, & John Naisbitt & Patricia Aburdene, Re-inventing the Corporation, (New York, 1985), pp. 139-168

A. TEACHERS SHOULD UTILIZE SIMILARITIES OF STRUCTURE BETWEEN WORK AND SCHOOL TO PREPARE STUDENTS FOR THE DEMANDS OF LABOR MARKETS.

School work itself should be understood as preparation for participation in employment contexts. Teachers should place emphasis on development of habits of achievement, self-discipline, and hard work in school, and the similarity of habits leading to success in school and success in labor markets. Students who work extra hard or make high achievements should be rewarded and recognized for their achievements.

B. TEACHERS SHOULD EMPHASIZE THE VALUES OF IMPROVED QUALITY OF LIFE, AND THE USE OF WORK TO ACHIEVE THOSE VALUES. INCLUDED IS AN EMPHASIS ON WORK BEYOND ONE'S JOB.

Students should be encouraged to look for opportunities to improve their lives both within and beyond employment. They may be urged to compare working after school as a kind of moonlighting, and they be encouraged to carefully select outside employment work activities which better their situation, such as further training.

C. TEACHERS SHOULD EMPHASIZE THE VALUE OF NONREMUNERATIVE WORK, SUCH AS WORK WHICH IMPROVES LIVING CONDITIONS.

As a fundamental activity which is intended to improve one's life, work should be seen as having labor market and volunteer variants. Students should opportunities to understand the technologies and purposes of shelters or homes. They may then investigate techniques and work which improves living conditions. When jobs are unavailable, they still have opportunities for hard work which improves their situation, including work oriented toward improving shelter conditions, and oriented toward finding a job. Where a unit focuses on improving shelter, teachers may seek to include parents, and students may be asked to do investigations to determine local neighborhood conditions.

D. TEACHERS SHOULD INCULCATE HABITS OF CREATIVE PROBLEM SOLVING AND INVESTIGATION ALONG WITH DEVELOPMENT OF THE CORRESPONDING SKILLS.

Teachers may use everyday problems students face to provide opportunities for rewarding creative problem-solving efforts. Students should be given a sense of realistic hope, including that they may rely on their own ingenuity to solve the problems they face. Teachers should use examples beyond traditional academic contexts, and encourage students to habitually approach nonacademic problems in this manner.

E. TEACHERS SHOULD NOT PERMIT DEBILITATING SELF-INTERPRETATIONS, AND SHOULD POINT OUT HOW INTERPRETATIONS ARE DEBILITATING.

Many television programs, news stories, leaders, and significant others convey "victim" roles to minority students. But these roles are debilitating, since they tend to choke off effective response. Realistic optimism, scripts with positive outcomes, and the like should be emphasized along with the debilitating nature of victim roles.

F. TEACHERS SHOULD EMPHASIZE THE CENTRALITY OF LEARNING FOR STUDENTS.

There are many pressures which distract students from the central task of learning, but doing so undermines the educational process. Clear distinctions need to be made between the task of education and other activities and distractions. No other activities and distractions should be allowed to distract students from the central task of learning.

G. TEACHERS SHOULD EMPHASIZE THEIR FAITH IN THE POTENTIAL OF EVERY STUDENT TO LEARN THROUGH HIS OR HER OWN EFFORT.

Success in the learning process itself should involve emphasis on those aspects of learning which are under the student's control. Sometimes students fear that they cannot learn difficult material, but this can be countered by persistent encouragement of teachers. Students should be challenged to do the maximum they can do to learn. Here, it is important to emphasis that students are more equal than different, and can STS themes include major social issues such as population growth, world hunger, air quality, war technology, energy shortages, land use, disease, hazardous substances, and the robot revolution. A course problem may be posed which requires that students define the problem narrowly enough so that it is actionable, gather information about it and diagnose its causes, formulate and assess relevant value issues, specify alternative solutions and plans, evaluate the alternatives, and engage in some appropriate action. Because of the complex and interdisciplinary nature of STS issues, solving problems in this area should develop skills which are transferable to employment contexts.[3]

B. THE LEARNING PROCESS SHOULD EMPHASIZE COLLABORATIVE ACTIVITIES AMONG STUDENTS, AND THE DEVELOPMENT OF INTERPERSONAL SKILLS.

Pooling human and other resources is a very important ingredient in dealing with employment questions, which people often approach individually. So students should have the experience of using combined resources and information to solve problems. It is very likely that group support and problem-solving efforts will add to the ability of minority youth to meliorate employment difficulties. Especially important are the interpersonal skills developed in group problem solving activities, including skills in communicating, taking and giving instructions, empathizing with and understanding what others are thinking and feeling, leadership, and negotiation.

C. THE LEARNING PROCESS SHOULD FACILITATE THE DEVELOPMENT OF INVESTIGATIVE SKILLS.

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[3] Thomas P. Rohlen, "How Japanese Education Works," Harvard Educational Review, Vol 65, No. 5, Sept-Oct., 1987.

Students should opportunities to learn how to observe, make applied math computations, compare and contrast, gather information, and find out how machines and tools work.

An example would be a post-industrial urban geography project which involves students in identification of where and what types of jobs there are in urban rings. Students may do calculations of the number of available employment locations within a specified number of miles and distance of travel. They may also develop ratios of manufacturing and service jobs. They may record observations at worksites of the people that worked there, what people told them about what they do for work, and of their reactions to employers they interview. Given the crisis nature of minority youth employment, such a post-industrial unit ought to be mandatory.

D. LESSONS AND UNITS SHOULD PROVIDE OPPORTUNITIES FOR STUDENTS TO INTERVIEW EMPLOYERS.

In a post-industrial urban geography project, for example, students may be asked to interview employers concerning the nature of the employer's business, and the technologies of production the employer uses. They may also ask what new technologies the employer expects to use in the next five years.

E. LESSONS AND UNITS SHOULD INSTRUCT STUDENTS IN THE SCIENTIFIC METHOD AND OPPORTUNITIES FOR ITS ON NONSCIENCE AND EVERYDAY PROBLEMS.

Scientific methods of experiment and observation could then be seen as useful both for finding out what uniformities there are in the natural world, and for finding out what patterns there are in work related situations. For example, they may use such methods to approach problems of why they are or are not getting hired, or they may use such methods to solve problems on the job.

F. LESSONS AND UNITS SHOULD DEVELOP SKILLS WHICH FACILITATE ADJUSTMENT TO RAPID CHANGE IN THE LABOR MARKET, AND WHICH ENABLE STUDENTS TO COMPETE FOR ENTRY POSITIONS IN HIGHER LEVEL JOBS.

It is especially important the students develop a habit and skills oriented toward the changing nature of work. Basic skills in writing, reading, and computation are important, and so are entrepreneurial skills and creativity. A students who learns basic math concepts, for example, will have an easier time with new applications than one who has never had such exposure.

2. LESSONS AND UNITS SHOULD EMPHASIZE WORK ETHIC VALUES AND HABITS, AS THESE RELATE TO LABOR MARKET SUCCESS.

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H. TEACHERS SHOULD MAINTAIN THE QUALITY OF THE EDUCATIONAL PROCESS, ESPECIALLY AVOIDING THE DIMINISHING OF EXPECTATIONS.

Students may not believe in themselves or may be tempted to lower expectations for themselves. Also, teachers may feel pressure to collude with students in diminishing learning expectations. Teachers must be resist these pressures, and point out to students that they will have the most the gain from resisting the temptation to diminish expectations. Also, teachers must have and show genuine caring for the learning of students, including a vision of what students could do with their lives if they commit themselves to the task of learning.

PART II: STS CONTENT RECOMMENDATIONS

1. LESSONS AND UNITS SHOULD EMPHASIZE UNDERSTANDINGS OF TECHNOLOGY AND THE WORLD OF WORK.

A. GEOGRAPHY UNITS SHOULD EMPHASIZE URBAN GEOGRAPHY IN A POST-INDUSTRIAL SOCIETY.

Students may be asked to identify industrial mixes in their urban areas, and in the rings of their cities. They could use push pins to plot the distribution of types of jobs on a map of their cities. Investigation of "rings" of a city may be done as an after school field or homework project. It would help students to gain valuable information concerning the types and quantity of business activity in their city. Included in this will be development of lists of technologies used by businesses, and explanations of what each technology does. Such post-industrial geography units ought to be mandatory for urban minority youth.

B. A LESSON OR UNIT CAN SHOW USES OF THE SCIENTIFIC METHOD AS APPLIED TO TECHNOLOGICAL INNOVATION RATHER THAN TO A SCIENCE PROBLEM.

Students may learn how scientific methods are used to test engine performance, for example. Science courses can emphasize scientific method which may be used to test technological innovations. Comparisons could be made with technological innovations in the history of technology (steam engine) which did not use background theories of science, such as thermodynamics.[4]

C. ALL LESSONS AND UNITS SHOULD EMPHASIZE CAREER OPTIONS ASSOCIATED WITH THE SUBJECT TAUGHT IN THE LESSON OR UNIT.

Because minority youth will of necessity have to move into new career areas, it is imperative that career options be outlined as part of every lesson. Also, given that teachers may not be aware of all available careers, regular updated materials, such as pamphlets, should be prepared for them by those specializing in tracking new careers.

D. LESSONS AND UNITS IN SCIENCE COURSES OUGHT TO EMPHASIZE THE TECHNOLOGIES ASSOCIATED WITH A GIVEN SCIENCE.

This is crucial since technolologies--including productive technologies--are closely intertwined with work. A physical science unit, for example, could emphasize engines and their many uses. Also, where such technologies are used in the workplace, associated careers may be discussed, such as auto mechanic.

E. LESSONS AND UNITS SHOULD DISCUSS THE NATURE OF INFORMATION AGE TECHNOLOGIES, AND ITS EFFECTS ON JOBS.

A unit could cover the robot revolution and jobs. One exercise would be to itemize jobs created and jobs lost, and jobs which were changed by the robot revolution. Also, discussion about the differences of manufacturing and service jobs should be considered, along with the information components of many new jobs. Students should have an opportunity to use a computer as part of such a unit.

F. LESSONS AND UNITS OUGHT TO EMPHASIZE THE UNIQUE EFFECTS OF NEW TECHNOLOGIES ON THE INNER CITY BLACK AND HISPANIC COMMUNITIES.

This ought to be a mandatory unit where students learn what has happened to the labor markets in urban areas, and how that is effecting their parents and them. This unit may also consider the secondary labor market jobs created by the post-industrial changes in urban America. Further, it could consider the effects of technology on African countries, including the effects of microelectronics.

G. LESSONS AND UNITS MAY EMPHASIZE THE HISTORICAL RELATIONS OF TECHNOLOGY AND WORK, WITH SPECIAL ATTENTION TO IMPACTS ON THE BLACK AND HISPANIC COMMUNITIES.

History courses, for example, may involve units which emphasize the interplay of technological developments and work, such as with the cotton gin and its impact on the black community. Such courses may compare scientific and technological revolutions.

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[4] Faith M. Hickman, John Patrick, & Roger W. Bybee, "Science, Technology/Society: a Framework for Curriculum Reform in Secondary School Science and Social Studies," (Colorado, 1987), p. 32.

Again, emphasis should be placed on the differential effects on blacks.5

H. LESSONS AND UNITS COULD EMPHASIZE DISCUSSIONS OF QUALITY OF LIFE AND THE ROLE OF TECHNOLOGY AND WORK IN PRODUCING HIGHER STANDARDS OF QUALITY OF LIFE.

Civic courses may emphasize quality of life in communities. Consideration should be given to the use of technology by police to control crime, and the associated values and issues. Special attention should be given to destructive effects of racism on fulfillment of community values. Discussion of community values such as stability, peace, material prosperity, and fairness may facilitate the importance of creating a context conducive to business activity.

I. LESSONS AND UNITS MAY FOCUS ON ECONOMICS, TECHNOLOGY, AND WORK.

Economics courses may focus on the impacts of mass production and Taylorism on workers, and may include units on the economies of inner city tracts, together with the impacts of new technologies on these economies. Discussion of informal and marginal economic activity would be appropriate, and of black capitalism as an economic alternative for these inner city tracts. Ingredients of economic growth should be considered, as well as the concept of scarce resources, trade-offs, and competition.

J. LESSONS AND UNITS SHOULD FOCUS ON THE EMPLOYMENT CONSEQUENCES OF DECISIONS IN EARLY LIFE.

A module on a career decision tree may be useful, with students constructing a model of what will happen with each decision concerning career variables. Such a unit would need to be developed so that students could see implications of various choices early in their education. Included within this would be real options of students, such as "dropout and work," "dropout and deal with drugs," "go to college," "take a job at McDonalds," and the like. Students might then be instructed to invent ways of getting out of "traps" in each branch of the tree.

K. IN LESSONS AND UNITS STS UNIFYING CONCEPTS CAN BE APPLIED TO UNDERSTANDINGS OF TECHNOLOGY AND WORK, WITH EMPHASIS ON URBAN AREAS.

STS unifying concepts, such as systems and subsystems, organizations and identity, hierarchy and diversity, interaction and change, growth and cycles, patterns and processes, probability and prediction, conservation and degradation, adaption and limitation, and equilibrium and sustainability could each be applied to and illustrated with technology and work issues.

L. LESSONS AND UNITS OUGHT TO EMPHASIZE ALTERNATIVES, SUCH AS BY COMPARISON OF IMMIGRANT AND MAINSTREAM ECONOMIES AND JOBS.

5Jim Stewart, Director of Black Studies, Penn State University, has emphasized this theme in several lectures and discussions.

A unit could involve discussion of how work is closely tied to cultural values, and how work is often a definitive activity in a given culture. Units on immigrant groups show how opportunities for work vary with cultural values. Students may examine their own values and how they are reflected in the work they do. Also, where television tends to promote mainstream elite occupations, students should be given opportunities to see the attractiveness of alternatives. Students should see how the evolution of values gives rise to new kinds of work, just as it gives rise to new directions in technological development.

M. MANDATORY LESSONS AND UNITS SHOULD TRAIN STUDENTS IN JOB AND MONEY MANAGEMENT SKILLS.Such a unit would include techniques of money management in home and business, entrepreneurial skills, job hunting skills, office politics and job holding skills, oral self-presentation skills, skills in selecting clothes and projecting images to others. Such units should also give instruction through providing students opportunities to get feedback on their impacts on others. Students might role play ways of approaching employers, and ways of answering employer questions and comments. Such units should be mandatory for all students, and full of useful information.

N. MANDATORY LESSONS AND UNITS SHOULD PROVIDE INTEGRATIVE INTERPRETATIONS OF TEEN WORK EXPERIENCE AND ATTEMPTS TO FIND WORK.

As noted, teens often have work experiences with little training attached. Since these experience have major impacts on students, they should be interpreted and understood in lessons and units. Emphasis might be placed on what students spend money on when they do work, and whether that has the best value for them. They should understand the opportunity cost of not saving or not spending money on other items. Also, discussion might focus on work ethic values, expressive values, and economic values of work. Students could be asked what they want to do as a career and may engage in values clarification exercises aimed at narrowing career choices. The teen work experience and the experience of not finding a job could be cast in the framework of systems and organizations. Also, such experiences could be used to explain how labor markets operate.

O. LESSONS AND UNITS OUGHT TO EMPHASIZE THE MANY DIFFERENT ASPECTS OF WORK, AND THAT LEARNING JOB SPECIFIC SKILLS ARE ONLY ONE--ALBEIT IMPORTANT--PART OF WORK.

Students often think that getting a job involves learning some job specific skills and then getting a job in that area. But the role of attitude, interpersonal skill, work habits, cultural values concerning work, self-discipline, and general skills should also be emphasized. Students should understand the affects of racism in employers and techniques for dealing with racism.

GUIDELINES FOR INFUSING STS INTO SECONDARY SOCIAL STUDIES CURRICULUM IN THE INNER-CITY SCHOOL

Margarita M Peña
The Pennsylvania State University

Rationale

"Education for citizenship in a free society" is thelong-standing goal of Social Studies in the United States (Hickman, Patrick & Bybee, 1987). Citizenship in a free society can be understood by the individual's ability to function in a political-legal structure characterized as representative democracy. According to Newmann (1977), education for citizenship must (a) give student choices, (b) Maintain an atmosphere of intellectual openness, (c) focus on problems faced by the students in their role as citizens, and (d) place students in active roles so they can use their knowledge to participate in the political process. Because of the complexity of the issues dealt with in contemporary social life, it is important that citizenship education be strongly rooted in the knowledge that has been generated by the social sciences about the evolution of human societies and the way they have shaped and been shaped by the natural environment.

A "problems approach" to citizenship education allows us to see the connections between Social Studies and STS education clearly. "To deliberate adequately... the citizen needs to practice in grappling with the specifics of actual social issues (Newmann, 1977, p.2). This approach concentrates on particular social issues of current and predicted importance in the students'lives. However, although the problem is the focus of the study, knowledge from the disciplines is required to understand and explain such problems. The goal is then to avoid unsubstantiated activism, while avoiding the strictly academic, disciplined-oriented bias that often characterizes the social studies curriculum in the school.

Citizenship education has recently become complicated by rapid advances in science and technology and by rapid changes emanating from them (Engle & Ochoa, 1988; Hickman et al., 1987). In the more advanced industrial societies science and technology have merged into a complex of unprecedented power. More than ever before, technology has penetrated every realm of human life. The idea of a technology-dominated world is frequently taken for granted, and so is the notion of technology as a determinant factor in contemporary society. These assumptions account for the helplessness and apathy that often characterize the public's attitude towards technological matters.

But science and technology are essentially a social enterprise and their development depend upon of the purposes and intentions of individuals in given social and political settings. The control over the direction of science and technology is subjected to negotiation between individuals and groups with different interests and assumptions, and the results of this political process are of great social importance given not only the destructive power of the techno-scientific power, but the need to maximize its benefits Roy, 1986).

However, the pace at which technological change takes place in the present era, as well as the increasing concentration of decision-making power concerning technological development, have led the common citizen o the wrong conclusion that technological development is beyond his/her understanding and control. The resulting attitude is one of helplessness and political apathy. This may be particularly true among minority groups in inner-city areas. Historically, these groups have been the ones mostly affected by technological changes in the productive milieu (Stewart, 1986). As Flint (1986) points out, "in a variety of ways--some understood and some not, technologies an and do victimize minority individuals and communities" (p.5).

In the case of the inner-city youth, more likely to perceive themselves powerless and marginal to the democratic process, it is important that they be empowered for seeing themselves as active members of the society and gain a perspective of how and why developments in science and technology have a particular impact on them, because of their history and role in the economic system. Educational processes focused on the interface between science, technology and society are essentially citizenship education. They are a resource for minority communities to empower themselves and "overcome the victimization by technological change" (Flint, 1986, p. 5). Understanding the economic and political forces behind the evolution of science and technology in modern society is a condition for students in the inner-city to become aware of the actual and potential sources of control over science and technology. This understanding is at the very base of a collective reflection on how undemocratic forms of control can be reversed.

Guidelines for infusing STS issues in the Social Studies curriculum in inner-city schools

Sources for this section are the Guidelines for STS Education for Urban Youth developed by the STS Program at The Pennsylvania State University (S-STS Reporter, 1988), and the guidelines recommended by the Social Science Education Consortium (Hickman et al., 1987). The guidelines also reflect the opinions of experts in Social Studies curruculum.

General guidelines

- Infuse STS issues at relevant points across the secondary school curriculum.

  In the case of social studies, STS issues can be connected to favorable entry points in standard social studies courses in the core curriculum. Content and learning activities on science and technology are more likely to be infused in the social studies curriculum if they fit particular themes, topics, and concepts of standard courses. Examples of this entry points are the Scientific revolution in Europe, the Industrial Revolution, the transformation of agricultural techniques during the 19th and 20th century, the growth of cities as a result of industrialization, and so on.

- Begin with STS issues perceived relevant by students and then include additional issues viewed as relevant by teachers and experts.

Knowledge guidelines

- Treat interrelationships of science and technology in a social context.

  The science-technology interface always exists in a social context. In involves individuals as well as government and private institutions and processes associated with the practice and achievements of science and technology. It is important that students learn how the government, the military, as well as private business, foster developments in science and technology.

This guideline also involves the analysis of the extent to which public opinion and attitudes affect the practice and uses of science and technology in different social systems.

- Emphasize the uses, limits, possibilities and variable social consequences of scientific and technological endeavors in the past and present, locally, nationally and globally.

  Developments in science and technology are associated with social continuities and changes. Students should learn about science and technology as part of the social and economic history of their nation and the world. Furthermore, they must learn about the social origins and social effects of science and technology. In the particular case of the inner-city school important that students learn about the specific ways in which minority communities in the United States have been affected by technological change. It is also relevant to highlight scientific and technological achievements in African, Caribbean and Latin American societies as well as those of American minority scientists/inventors, emphasizing the limitations preventing these groups from making more contributions to science and technology.

- Stress that science and technology have been fundamental elements of Western civilization, including the United States.

  Values associated with practices and products of science and technology are major components of Western civilization. The development of the Western world, its political and economic preeminence, has been linked to the evolution of science and technology. It is important that students learn the relationship between scientific and technological capabilities and its dominant or subordinated position in the world economy.

Societal issues guidelines

- Examine past and present social issues associated with the effects of scientific and technological practices and products in the inner-city environment, e.g., historical account of the way the city's layout has evolved, the environmental and demographic changes associated with technological change, and analysis of technology-related problems directly affecting their community (pollution, waste, public transportation, etc.).

- Help students understand that they are interdependent members of and urban society and that they have personal group choices. Foster understanding that all technologies have costs and benefits associated with them and assist students in critically evaluating their implications within their urban environment.

- Assist students to utilize knowledge and experiences of urban life to identify community STS issues. Students can be helped to recognize and deal with local issues as they arise within their daily lives.

Guidelines for decision-making and action

- Encourage students to understand their thinking process in reaching decisions on STS issues with a view toward improving their higher order thinking skills.

  Higher order thinking involves judgement, uncertainty and finding structure in apparent disorder; it involves the application of multiple criteria and yields multiple solutions, each with costs and benefits (Resnick, 1987). The goal in dealing with STS issues through Social Studies is to move students increasingly away from a purely emotive response to decision-making situations to a reasoned reflection of the problem and the alternative solutions.

- Promote responsible social action (participation) once relevant STS issues have been identified and studied. Actual participation in the political process is central to citizenship education because young people are citizens now, and not merely preparing for citizenship (Conrad & Hedin, 1977). Students should be taught and encouraged to lobby for their views at local community meetings.

  Skills required to participate in civic life can be acquired through (a) voluntary service with social agencies, (b) community projects involving the organization and participation in group efforts toward common goals, (c) firsthand community studies, and (d) social and political actions aimed at influencing public decision-making.

Career-preparation guidelines

- Demonstrate how individuals with an understanding of the social impact of science an technology can make a positive contribution to the uban environment. Evaluate the contributions of professionals in social sciences-related careers (e.g. economists, sociologists, historians, etc.) to the improvement of the conditions in inner-city areas, and indicate the students the way to enter these careers.

- Explore tasks performed by government employees government in social service agencies and environmental regulation offices.
- Help students understand the impact of technological change in the job system of the country and examine the effect of new technologies in manufacturing and office jobs. Students should learn the value of gaining knowledge and skills that allow them to change jobs when facing technological displacement. Students must also be able to appreciate the value of work and the importance of having a food education as a condition to function in a society characterized by rapid technological changes in the productive milieu.

References

Conrad, D. & Hedin, D. (1977). Citizenship education through participation. In National Task Force on Citizenship education. Education for responsible citizenship (pp. 135-155) New York: McGraw-Hill.

Engle, S.H. & Ochoa, A.S. (1988). Education for democratic citizenship: Decision-making in the social studies. New York: Teachers College Press.

Flint, D. (1986). Science, Technology and Society education for minority students. S-STS Reporter, 2(4), 4-6.

Hickman, F.H., Patrick, J.J. & Bybee, R.W. (1987). Science, Technology and Society: A framework for curriculum reform in secondary school science and social studies. Boulder: Social Science Education Consortium.

Newmann, F.M. (1977). Alternative approaches to Citizeship Education. In National Task Force on Citizenship education. Education for responsible citizenship (pp. 175-187) New York: McGraw-Hill.

Resnick, L. (1987). Education and learning to think. Washington DC: National Academy Press.

Roy, R. (1986). Tourists in their native land or college education for century XXI Unpublished notes. The Pennsylvania State University.

Splittberger, G. (1988 November). Scientific and technological literacy and the development of democratic behavior for citizens. Paper presented at the National Council for Social Studies Conference.

Stewart, J. (1986). STS and Black Studies: Partnership for progress in the 21st century. Bulletin of Science, Technology and Society, 6(2 & 3), 316-318.

FORMULATION OF A ONE-YEAR COURSE OUTLINE FOR AN STS COURSE FOR URBAN AND MINORITY STUDENTS

One of the express purposes of this project was the formulation of a one-year course outline for an STS course in urban schools with large minority student populations. A diverse group representing classroom teachers and university professors in several areas met together at The Pennsylvania State University on May 21, 1988. The members of this group, along with their prime areas of expertise and affiliation were: Dr. Ed Fagan (English, Professor of Education, Penn State); Dr. Dana Flint (Philosophy, Professor, Director of STS Program, Lincoln University); Raj Rajan (Chemistry, high school teacher, Philadelphia Public Schools); Dr. Peter Rubba (Science Education, Associate Professor of Education, Penn State); Bill Strain (Biology, high school teacher, Philadelphia Public Schools); Dr. Cora Turpin (biology, high school teacher, Philadelphia Public Schools); and Dennis Cheek (Science Education, STS Program, Penn State).

The document "A One-Year Course in STS," produced by the S-STS Project (an NSF-funded project to promote STS education at precollege levels) was the basic starting point for this formulation effort. Using group discussion and consensus, the original document was adapted in a form similar to the one below. A complete copy of this document was then forwarded to all project participants and feedback invited. Minor revisions were made based upon the feedback received and the final document follows:

A ONE-YEAR COURSE IN STS FOR URBAN AND MINORITY STUDENTS

I. Introduction

There is a pressing need for a more relevant science curriculum for urban and minority students. This suggested course outline is intended to provide guidance to teachers and administrators who wish to design a course in science, technology, and society that will be sensitive both to the urban context of the school and the needs of minority students who are often the majority in the inner city. This involves an emphasis on multicultural learning experiences and local, community or city-wide issues in STS.

II. The Goals of an STS Course

A. To show the interrelationship of science and technology in a multicultural society.

B. To develop the learners' understanding of themselves as interdependent members of urban society interacting with science and technology, with particular emphasis upon the effects of this interaction upon the urban ecosystem and of nature upon society.

C. To explore broad considerations of science, technology, and society including personal and multicultural values and ethics.

D. To develop problem-solving and decision-making skills, including explicit attention to intuition, visualization, and value assumptions, and to apply these skills to every-day social issues involving science and technology.

E. To foster learners' confidence in using and understanding scientific and technological information (qualitative and quantitative) in at least one limited area as a basis for making judgments about STS issues.

F. To encourage learners to become involved in a personal course of action after investigating issues for many sides and weighing the advantages and disadvantages of differing viewpoints about STS issues and options.

G. To foster career decision making, especially in light of the values implicit in work and certain STS vocations.

III. What Should the Course Deal With?

A. The characteristics of science, technology, and society.

B. Perspectives on science, technology, and society:

- historical
- values and ethics
- political
- global
- aesthetic
- sociological

- economic - ecological -local and national
- individual and family

C. Some STS topics and organizing concepts

1. Social

   a. Some organizers: rules and practices, communication, governmental/legal norms, constructions of reality, motivation, interdependency, priorities

   b. Some issues: advertising, the family and home, the value of education, the homeless, mental health in the city, day care, teenage pregnancy

2. Scientific

   a. Some organizers: cycles, fields, interdependency, force, systems, interactions, energy/entropy, change, structure, time, matter, space, information, conservation, values

   b. Some issues: toxic waste, acid rain, food and agriculture, pseudoscience, AIDS and other STSs, blood pressure and stress, illicit drugs, forensic science, urban plant life, rodents, urban insects, urban parasites, water pollution, air pollution, contraception

3. Technological

   a. Some organizers: production, innovation, distribution, tradeoffs, logistics, interdependence, entrepreneurship, values, power, finite resources/ limits, networks

   b. Some issues: genetic engineering, food packaging, weapons manufacturing and distribution, urban environment systems management, trash management, urban stress, fast food technology, television, noise pollution, mass transit, human factors engineering

IV. How Can It Be Taught? What are the Strategies?

A. Start with social problems and issues, then proceed to:

- the technological processes and devices behind those problems and issues

- the basis science of the processes and devices

- problem solving, decision making, and action taking

OR

B. Start with technological processes and devices, then proceed to:

  - the science on which these processes and devices are based

  - the social problems and issues which arise from them

  - problem solving, decision making, and action taking

OR

C. Start with scientific concepts and principles, then proceed to:

  - the technological processes and devices that either arose from the science or allowed the science to be discovered

  - the social problems and issues which arise from them

  - problem solving, decision making, and action taking

V. How Do We Go About Doing This? What Techniques Do We Use?

A. Organize the course around topics like those outlined in III above, using one or more strategies described in IV, covering a range of subject matter, emphasizing environmental, technical, economic, political, historical, ethical, etc. considerations

B. Include issues which meet the interests and aptitudes of students and teachers that:

  1. relate to the lives of these students, their families and the urban community.

  2. emphasize connections to themes of broader (regional, national, global) significance.

C. focus on practices and procedures by which knowledge of STS issues is gained by asking "How do we know?", "Why should we care?", and "What can we do?".

D. Gather information from diverse sources and communicate it in a variety of ways: written, verbal, graphic, etc.

E. Encourage students to explore their emotions and values and those of others in relation to specific issues.

F. Practice decision making strategies leading to action on real problems.

G. Give interdisciplinary perspectives by bringing together teachers and urban community leaders from the arts, social sciences, natural sciences, and the technical arts.

H. Draw on the various sources available in the urban area, e.g. industry, government, the press, religious organizations, and public interest groups.

I. Use a variety of instructional techniques including video, computer, film, print materials, student projects, case studies, debates, field trips, role playing, simulations, games, and community based experiences.

GUIDELINES FOR STS EDUCATION FOR URBAN YOUTH

The United States Department of Education has provided support for an investigation of the potential contribution of STS in large urban school districts in the northeast region of the nation. Since minority students make up a majority of the high school populations in these districts the study was designed to be sensitive to these needs. Other areas of the nation might benefit from this effort and use these recommendations as a starting point for reflecting on their regional needs. The main goal of the study has been the formulation of guidelines that could be utilized by curriculum developers, school districts, and individual teachers wishing to include STS materials specifically tailored to the needs of urban students. This article presents the guidelines in their current form, and invites response from readers of the Reporter.[1]

A starting point for this endeavor were the stated guidelines of the S-STS Project. These were assumed from the outset to be operative and useful for all students studying STS issues. They are as follows:

1. To make clear the relations of technological and scientific developments to socially relevant issues.

2. To show the influences of Technology, Science, and Society on each other.

3. To develop the learners' understanding of (a) themselves as interdependent members of society and (b) the effects of society upon the eco-system of nature and of nature upon society.

4. To examine differing viewpoints about STS issues and options.

5. To explore broad considerations of science, technology, and society including personal and societal values and ethics.

6. To develop problem-solving and decision-making skills, and to apply these skills to everyday questions and to social issues involving science and technology.

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[1] The "Improving Secondary Science through STS for Urban and Minority Learners" Project was funded by the U.S. Department of Education under Grant No. G008610608. Project Director, Leonard J. Waks

7. To encourage learners to become involved in a personal course of action after weighing the advantages and disadvantages of the different options in STS areas.

8. To foster learners' confidence in using and understanding quantified, scientific, and technological information in at least one limited area as a basis for making judgments about STS issues.

Early in the project a series of background review papers explored such topics as urban minority students problems and prospects in regards to employment; science education and minority students; a framework for STS educational efforts in science; social studies, reading and language arts problems; and multi-ethnic education. Working from preliminary drafts of these papers, a set of provisional guideline statements was drawn up for feedback from participants within the project, including inner city science teachers, university professors and researchers, and science supervisors for several large urban school districts.

The inner city science educators are from the Philadelphia Public Schools and are as follows: Maria Arguello, Alflorence Cheatham, Raj Rajan, Bill Strain, and Dr. Cora Turpin. Academic contributors have included Drs. Mary Dupuis, Edward Fagan, Peter Rubba, and Jim Stewart of The Pennsylvania State University, Dr. Judith Thomas of the Philadelphia College of Textiles and Science, and Dr. George O'Brien of the University of Pittsburgh. Science Supervisors involved in this project have included Mary Ann Brearton, Maryland State Science Supervisor; Dr. Anthony Galitsis, Director of Science for the New York City Board of Education; Edward Malin, Red Clay School District (Wilmington, Delaware); Doris Litman of the Pittsburgh Science Institute and Dr. Donald Steinberg of the School District of Philadelphia. Additional feedback has been provided by the following persons outside the project: Juanita Chambers, Math and Science Supervisor for the Detroit Public Schools; Dr. Asa Hillard of the Georgia State University and consultant to the Detroit and Portland (OR) Public Schools; Dr. Paul DeHart Hurd, Professor Emeritus of Science Education, Stanford University and currently Research Associate of the Carnegie Foundation, Washington, D.C.; Dr. Dianne Robinson of Hampton University; Dr. Marilyn Suiter of the American Geological Institute; and Joann Stevens of The National Urban Coalition. The project is a Penn State grant, with Dr. Leonard Waks, Professor of STS at Penn State as the project director. Dr. Dana Flint of Lincoln University directs the Lincoln University contingent of the project. Dennis W. Cheek, a graduate assistant at Penn State, coordinated the formulation of the guidelines. Their direction and input has been critical the success of this project. The participation of all of these interested persons does not imply endorsement of the guidelines as they are presently framed.

Initial responses to the first round of guideline statements resulted in much revision, elimination of some items, and the addition of other proposed statements. A second round achieved a high degree of consensus with the previso from many respondents that further work was necessary. What follows are the guideline statements as they now stand with short annotations that attempt to encapsulate the meaning of each statement. We solicit your feedback. Please address your comments to the STS Program at Penn State, Attention: Dennis Cheek. All responses are invited, including suggested reformulations, additional examples, better delineations, etc. The assistance of Maria Arguello, Dana Flint, Raj Rajan, and Cora Turpin in providing examples is gratefully acknowledged.

GUIDELINES FOR STS EDUCATION FOR INNER CITY YOUTH

1.0 GENERAL GUIDELINES

1.1 Infuse STS issues at relevant points across the secondary school curriculum.

STS education should not be limited to science classes but should be an integral part of general education at all points within the secondary curriculum. History classes might focus on the impact of assembly line production techniques on urban life; an art class might study architectural design of schools and urban buildings; food preservation techniques and how they have shaped urban life styles might be considered in home economics classes, etc.

1.2 Begin with STS issues perceived relevant by students and then include additional issues viewed as relevant by teachers and experts. Focus especially on topics that are likely to require on-going citizen attention in students' adult lives.

Examples might include euthanasia and related issues of Medicare/Medicaid funding; the roles of teenagers in an urban society in regards to fads, fashions, and consumerism; and the problems of solid waste disposal in urban environments.

2.0 STS KNOWLEDGE GUIDELINES (these statements are linked to goals 1 and 2 of the 8 S-STS guidelines above)

2.1 Provide all learners with sufficient knowledge of concepts in the natural and social sciences and the interaction

between science, technology, and society to enable them to make informed decisions on STS issues.

Examples would include scientific and social conceptions of race and the unity of mankind from a biological perspective. Crucial concepts and information related to the complex questions that arise over abortion is another example where students can only make informed decisions after considerable efforts have been expended in getting the facts straight and weighing the relative merits of various theories and explanations.

2.2 **Emphasize the use of scientific process skills that can be applied within the context of STS issues and in students' daily lives.**

The basis science processes are observing, classifying, communicating, measuring, using space/time relations, using numbers, inferring and predicting. These skills provide a foundation for learning the more complex skills of controlling variables, interpreting data, formulating hypotheses, experimenting, and defining operationally. Instead of introducing these skills abstractly they should be introduced when they arise within concrete situations of the urban environment.

2.3 **Encourage students to undertake hands-on scientific investigations that relate directly to their day-to-day experiences in their personal environments.**

Some sample topics include hair lotions and their relative acidity, household cleansers, collecting and analyzing particulate matter in the urban environment, and hearing levels and urban noise.

2.4 **Emphasize effects of technological innovations in urban areas and on minority communities within the city.**

The disposal of toxic wastes, hair and makeup products, noise pollution, routinization of tasks within fast food establishments, and the manufacturing of illicit drugs might be some examples examined.

2.5 **Include material highlighting historic scientific and technological achievements in African, Caribbean, and Latin American societies as an integral part of an STS curriculum.**

African and Precolumbian civilizations' solutions to problems such as water distribution, irrigation and crop cultivation, and "urban" administration should be brought to students' attention.

2.6 **Highlight American minority scientists/inventors whose experiments were critical to American scientific and technological achievements.**

The purpose is to feature minority scientists/inventors whose experiments in their sheer genius will excite and motivate minority youth in pursuing scientifically based careers as well as breaking down insidious prejudice of non-minority youths who can marvel at the skills and achievements of minority Americans.

3.0 **GUIDELINES FOR AN EMPHASIS ON URBAN ECOLOGY AND INTERDEPENDENCE IN URBAN ENVIRONMENT** (linked with goal 3 of S-STS guidelines)

3.1 **Select instructional activities that help students understand they are interdependent members of an urban society and that personal and group choices have important environmental effects on the urban ecosystem.**

An exploration of the limits that urban life places upon people in regards to cultivation of gardens, city parks and recreation areas, and strains of plants resistant to urban pollutants might be used. Urban animals might be studied and used to illustrate such concepts as a behavioral sink.

3.2 **Foster understanding that all technologies have costs and benefits associated with them and assist students in critically evaluating their implications within their urban environments.**

A detailed look at urban means of transportation and a comparison of the costs and benefits of mass transit versus private vehicular transportation would aid such understanding. High rises versus other types of dwellings, subterranean versus above ground construction, and traditional versus passive solar building designs also exemplifies the kind of understanding that should be encouraged.

3.3 **Demonstrate how individuals with an understanding of science, technology, and their impact on society, can make a positive contribution to the urban environment through careers and community involvement.**

Examples at the micro level could include design in inner city classrooms, the cafeteria, and the school as a whole. At the macro level, students could be exposed to civil engineers and how they shape the urban environment in areas like mass transportation, buildings, and other aspects of urban planning.

4.0 **GUIDELINES FOR DECISION MAKING AND ACTION** (linked to S-STS goals 4, 6, and 7)

4.1 **Assist students to utilize knowledge and experiences of urban living to identify community STS issues and propose and evaluate solutions to those issues. Promote responsible action in follow-up activities after such decisions are made.**

It is not enough to study about what others have done or are doing to shape and change their urban environment. Students must be helped to recognize and deal with local STS issues as they arise within their daily lives. They should be taught and encouraged to lobby for their views at local community meetings where decisions are being made on a continual basis that will affect them as well as others.

4.2 **Encourage students to describe their thinking processes in reaching decisions on STS with a view toward improving their higher order thinking skills.**

The goal here is to not only help the student sharing but also to hone others skills as they learn from one another the logical steps used to reach a decision. While values and emotions should play a part in decision making (indeed they must) the goal is to move students' increasingly away from a purely emotive response to decision making situations.

4.3 **Promote an understanding that STS issues are perceived differently by individuals based upon their different backgrounds, values, experiences, and knowledge.**

Some topics that might be explored which illustrate this goal are how different minority groups value schooling; the use of drugs and alternative medicine within different cultural groups; ethnic foods; and the types of tests that different cultural groups prefer in schools.

4.4 **Promote for students the realization that they are unique individuals with special skills and personal resources and their personal contributions on STS issues are important for all.**

All organisms are unique from peanuts to people. Each member contributes positively or negatively to urban environment. Ink blot tests and similar tests can be used to emphasize that even our visual perceptions are different and that in a multicultural society such perceptions must be tapped for the good of all. Many people have ended up on the wrong side of the law simply because no one listened to their special needs. Their positive contributions are missed by the society at large and their negative contributions are the penalty that society must bear.

5.0 GUIDELINES FOR LINKAGE OF STS TO CAREER PREPARATION

5.1 **Interweave instructional activities which explore career opportunities which rely on science and technology backgrounds, especially within the urban environment.**

The focus here must be on careers for all students and not solely on high paid careers in science and engineering. The fact that the majority of inner city students do not attend or complete college must be born in mind as opportunities are presented.

5.2 **Foster development of problem-solving and written and oral communication skills in relation to STS issues, especially those that can be transferred to employment contexts.**

An area that must be focused on in light of this guideline is the issue of changing demographic patterns in America, i.e. the aging of America and the associated growth in service oriented careers. Entrepreneurial skills must be developed to enable students to anticipate and take advantage of such a changing job market.

REVIEW OF MAJOR HIGH SCHOOL LEVEL STS CURRICULA IN LIGHT OF THE PROJECT GUIDELINES FOR STS EDUCATION FOR URBAN AND MINORITY STUDENTS

Dennis W. Cheek, Graduate research assistant, STS Program, The Pennsylvania State University, 117 Willard Building, University Park, PA, 16802; with reading assessments by Andrew Beigel, Graduate teaching assistant, Department of Curriculum and Instruction, The Pennsylvania State University, 160 Chambers Building, University Park, PA 16802.

Introduction

STS curricula for high school students have been available since the 1970's. Most of these curriculum efforts were local efforts to meet perceived needs to increase scientific and/or technological literacy for a greater proportion of high school students. A few projects, more national in scope and funding, sought to develop useful materials for a wide range of students and interests. Twelve important and widely disseminated material sets will be examined in this paper for congruence with the guidelines developed by this project.

Innovations- the Social Consequences of Science and Technology Program (Biological Sciences Curriculum Study)
Chemistry in the Community (the American Chemical Society)
Science and Technology in Society (the Association for Science Education, U.K.)
Science and Social Issues (Washington, D.C. Public Schools)
Department of Defense Dependents Schools (DoDDS)
Modular Science/Technology/Society Inc. (Wausau, WI)
Multnomah School District I-J (Portland,OR)
Math-Science Communications (National Coordinating Center for Curriculum Development - Minorities in Engineering Project, SUNY, Stony Brook)
You, Me and Technology (Agency for Instructional Technology)
Science in a Social Context (SISCON Project, Great Britain)
Preparing for Tomorrow's World (The Center for Coastal Studies, Rutgers University, NJ)
Concern Regarding the Environment and Technology in our Nation/Neighborhood (LaSalle, IL)

Format for the Reviews

Each program listed above was reviewed separately. A curriculum matrix of 14 criteria was constructed modeled from the 17 specific criteria developed as project guidelines for STS education of urban youth (see the Project guidelines and discussion elsewhere in this volume). Three guidelines, 1.1, 1.2 and 4.3, were not used as part of this matrix since two reflect policy rather than curriculum design and the remaining one does not appear in any of the curricula and thus, is teacher dependent for inclusion in learning activities. The guideline statements chosen were reorganized to reflect four basic areas: process skills, knowledge component, individual and group decision making, and social awareness and involvement. For the sake of brevity, each guideline statement was condensed. The degree and adequacy of the presentation in accomplishing a particular guideline was judged on a scale with the following criteria:

Minimal- 2 or fewer examples in the entire set of reviewed materials;

Fair- 3 to 5 examples in the entire set of reviewed materials;

Good- 6 to 10 examples in the entire set of reviewed materials;

Excellent- 11 or more examples in the entire set of reviewed materials.

While personal opinion obviously cannot be eliminated in this review process, an attempt was made by the reviewer to maintain consistency across material sets. The resulting curriculum matrix appears below.

GUIDELINES MATRIX FOR CURRICULUM REVIEW

	Degree and Adequacy of Presentation			
General Criteria Area	Min.	Fair	Good	Exc.
Process Skills 1. Emphasizes science process skills in daily urban settings				
2. Self-awareness of thinking strategies (metacognation)				
3. Written and oral communication skills emphasized, especially those enhancing job prospects				
Knowledge Component 1. Concepts from natural and social sciences in urban STS interactions are presented				
2. Effects of technological innovations in urban areas				
3. Historic African, Caribbean, and Latin American achievement in science and technology				
4. Historic American minority achievement in science and technology				
5. Urban "tradeoffs" presented				
6. Unique contributions of individuals promoted				
7. Career opportunities in science and technology presented				
Individual and Group Decision-Making 1. Hands-on investigation in local environment				
2. Decision-making on local STS issues				
Social Awareness and Involvement 1. Urban interdependency fostered				
2. Promotes involvement in constructive local action				

A discussion of each curriculum set is then provided with attention to specific strengths of the materials in promoting STS education for urban minority learners. Weaknesses within the materials in regards to the project guidelines are also highlighted with specific suggestions as to ways in which the materials could be modified by school districts or classroom teachers to more appropriately fit the needs of the target population. In fairness to all of the materials reviewed, it should be noted that most were not produced with urban populations of students in mind, particularly minority students. Any assessments as to curricular shortcomings in this area should not, therefore, be taken as a condemnation of the materials themselves or the work of their designers. The focus is on how well these materials might serve the needs of minority students in large urban school districts. Finally, for each set of materials there has been an assessment of matters relating to reading by a reading specialist. A rationale for the reading assessment and discussion of the procedures used will be described so that readers of this document might consider its utility and limitations both generally and for their specific local situation.

Rationale for the Reading Assessment

In order for any text to be of use, the presentation of the content is paramount. This presentation of the material can be labeled under the broad term "readability. Readability refers to the ease with which a student of a specified level or grade will be able to read a text. The traditional concept refers to a numerical measure of how sentence length, word choice and/or number of syllables in words relate to make a text more or less readable. We are proposing that this measure, though a well conceived notion, is not the panacea it would seem to be. We would like to suggest that there are other variables that critically impinge on the readability of a text. These include types of pictorial aids, types of in-text aids, text construction, position of questions and the use of highlighting to set off important text.

It is our contention that among the many variables that are included in a text, the factors identified above are important for the population we are concerned with in this project. With a great portion of the time in school, especially at the secondary level, being devoted to reading text related material, it is of vital importance that the texts be understandable to the reader (Cuban, 1984).

Text construction, i.e. the manner in which the text is laid out for the reader, is important for a number of reasons. The use of headings and sub-heads, for example, has an intuitive positive value. Learning is enhanced when there is a clear organization of material for the student to follow. The types of text construction needed are those that organize the text around themes or concepts. There is a need for profitable use of "white space" on the page to create an appealing and legible text.

Heading and subheadings provide relevant information that may not be clearly available in the text (Arnold and Brooks, 1976). We have defined the use of headings as short relevant statements which provide a student with a framework to guide his reading. These headings may be of varied lengths and varied styles, but must be statements that will ease any ambiguity that a student might find in a text.

The utility of pictures within the text material is not totally clear. It would appear that pictures, if clearly relevant to the text and presenting no new information, would be helpful in comprehending the text. We are choosing to include pictures in our assessment of the readability of various materials knowing that as Levin, et. al. (1974) documented, the facilitative effect of pictures is not equal for all students. We believe that a clear and clean pictorial representation of a concept can add a great deal to a student's understanding. There is a suggestion that the use of pictures in a text will cause a reader to use one or more imagery strategies that enhance learning (Rasco, et. al., 1975).

For our purposes, pictorial representations must be clear and clean, i.e. uncluttered with extraneous material. The pictures must also relate directly to the text in a clear and unambiguous manner and should be simple representations of material (concepts, examples, etc.) presented in written form.

Another factor that must be considered is the placement and types of questions provided with the text. Research has shown that embedded questions throughout the text will provide the student with greater understanding and ability to apply the material as compared to the exclusive use of post questions (e.g. Graves and Clark, 1981; White, 1981; and Watts and Anderson, 1971). Texts should place questions near the material to be learned as an aid to retention and comprehension. The questions can and should be of multiple levels.

A final consideration in evaluating these texts from a reading point of view is the manner in which new vocabulary words are presented. New vocabulary words should be presented in context with their definitions in close proximity on the page. Definitions should be highlighted along with the word to show the importance of the word and its meaning and to make learning the word and its meaning easier.

In our evaluation of the texts we have included a readability number based on the Fry Readability Scale. Although the concepts surrounding readability are somewhat cloudy, readability numbers present a ballpark figure from which to work when assessing the utility of a text for a given student population.

Procedures for the Reading Assessment

The procedure for evaluating these texts will be as follows. For the Fry Readability Score, three separate samples of 100 words will be analyzed using the general formula of the number of sentences in a hundred word passage and the number of syllables in the same passage. This tabulation will be done for all three passages and the average length and syllable count will be found. This set of numbers will be located on the appropriate Fry Readability Graph and an approximate grade level will be found.

For pictorial presentations, the pictures will be surveyed to determine if they are uncluttered and direct representations of the text with which they are associated. The pictures will also be considered in light of their placement with regard to the corresponding text material.

The use of headings and subheadings will be examined in light of the manner in which they explain the text. If the heading or subheading does not clear up ambiguity in the text then it will be labeled as being not useful.

Vocabulary presentation will be assessed to determine if the words are highlighted or set aside in some manner. The definition of the word must also be set aside in some manner and examples where appropriate are expected.

The placement of questions is just that. We will look at the text to determine if the questions are near the text for which they are intended. This means that embedded questions, small sets of questions at the end of bits of material, or questions to the side of appropriate text will be noted.

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ASSESSMENTS OF THE LEARNING MATERIALS
Innovations (BSCS)

The Biological Sciences Curriculum Study developed the program entitled "Innovations - The Social Consequences of Science and Technology" for high school students in 1980-81. Piloted in a number of schools and subjected to field trials, the set of five modules is now available from the Kendall/Hunt Publishing Company. The five modules are titled: "Computers and Privary", "Science, Technology, and Society: An Introduction, "Biomedical Technology", "Human Reproduction", and "Television". The curriculum matrix for the entire set of materials follows.

GUIDELINES MATRIX FOR CURRICULUM REVIEW

	Degree and Adequacy of Presentation			
General Criteria Area	Min.	Fair	Good	Exc.
Process Skills 1. Emphasizes science process skills in daily urban settings		X		
2. Self-awareness of thinking strategies (metacognation)	X			
3. Written and oral communication skills emphasized, especially those enhancing job prospects		X		
Knowledge Component 1. Concepts from natural and social sciences in urban STS interactions are presented		X		
2. Effects of technological innovations in urban areas	X			
3. Historic African, Caribbean, and Latin American achievement in science and technology	X			
4. Historic American minority achievement in science and technology	X			
5. Urban "tradeoffs" presented	X			
6. Unique contributions of individuals promoted	X			
7. Career opportunities in science and technology presented	X			
Individual and Group Decision-Making 1. Hands-on investigation in local environment		X		
2. Decision-making on local STS issues	X			
Social Awareness and Involvement 1. Urban interdependency fostered	X			
2. Promotes involvement in constructive local action	X			

Discussion

The fair to minimal marks that the Innovations program received is a reflection of a number of factors. First, the materials were not designed with minority learners and urban schools in mind. Second, the materials are not action-oriented but consist almost exclusively of read and discuss materials. Implications of this fact for minority learners in urban schools will be discussed below in the reading assessment. The focus on reading and discussion obviously precludes these materials from the process skills, individual and group decision-making, and social awareness and involvement components of the project guidelines.

Three of the modules, "Human Reproduction", "Television", and "Computers and Privacy", have some apparent utility if adapted in appropriate ways. The "Human Reproduction" module discusses the following topics: conception and contraception; teenage pregnancy; how sexual differentiation occurs; adoption; artificial insemination; and population control. Many of these topics are of obvious concern to the life of urban minority students. The materials need to be supplemented with activities and readings that present teenage pregnancy as a local STS issue. Student experiences in this area should be tapped in discussion. Economic, social, and psychological consequences can be explored using local community organizations and speakers. Visits to local abortion clinics and/or crisis pregnancy centers might be in order. Statistics from local hospitals about live births to teenage women coupled with racial and socioeconomic data could be used to provide substance to class discussions as well as teaching a wealth of skills in data collection and interpretation. The role of the social welfare system in teenage pregnancy and teen motherhood could be explored using student experiences and local agency officials. Demographic plots of the local community might also be a fruitful activity, especially if suitable demographic information can be obtained from other types of communities in the city for comparative purposes.

Television exerts a considerable influence on minority members of our society (see Cheek, this volume). The BSCS module "Television" covers topics germane to minority learners such as children and television, T.V. violence, advertising, cable T.V., and T.V. as a social force. The materials as they stand, however, fail to relate these matters sufficiently to the context of urban minorities. Specific student activities could include such matters as quasi-experimental designs that would result in some publishable research regarding T.V.'s effects on minority viewers - especially teenagers (for whom little research data exists); monitoring and critique of T.V. advertising - especially as it effects the black, urban community; discussion and debate about the need and benefits of such common technological devices as "boxes" and "walkmans" and the influence that advertising subtly exerts on shaping minority consumers' conspicuous consumption. Violence within the black community on the local level and the likely influence T.V. plays in such violence could be investigated using community surveys and crime statistics supplied by local law enforcement officials.

The "Computers and Privacy" module considers basic matters such as the uses and value of computers plus a look at the various kinds of records that are kept on computers and their use by law enforcement, insurance companies, medical facilities, educational institutions, etc. Once again, the materials as they stand are not suitable for minority learners in urban schools but can be creatively enhanced by well-chosen, relevant activities and discussions. These might include tapping into student experiences with juvenile authorities and the police, and medical facilities. The importance of one's school transcript in landing a job should be discussed (see Flint, this volume). Actual use of a computer would assist many students in grasping some of its uses and dangers - since we must assume that many have never had such experiences. The role of computer games (with which some will be personally familiar) and the ways in which they are shaping some teenage lives needs to be explored. Surveys of local residents' awareness of the kinds and types of records that are being "kept" on them by local authorities of various kinds could be explored. Greater community awareness about citizen rights in the area of computer data banks could be promoted by using students to host a seminar where information and examples are presented to the general public.

While the other modules in the series contain topics that are important to urban and minority students, the extensive amount of reworking needed to make these materials suitable probably does not warrant attention.

READING ASSESSMENT INSTRUMENT

MATERIAL SURVEYED: Innovations-The Social Consequences of Science and Technology Program

	Degree and Adequacy of Presentation			
Criteria	**Min.**	**Fair**	**Good**	**Exc.**
TEXT CONSTRUCTION a. use of headings and subheads			x	
VOCABULARY PRESENTATION a. highlighting the word in some manner	x			
b. proximity of definition to word	x			
c. use of appropriate examples where possible		x		
PICTORIAL/GRAPHIC REPRESENTATION a. clear and uncluttered pictures		x		
b. direct relationship to the concept		x		
c. proximity of picture to the text	x			
POSITION OF QUESTIONS IN THE TEXT a. post questions		x		
b. pre-questions	x			
c. contiguous questions	x			

FRY READABILITY SCORE: 9th Grade

Discussion

The reading material provided in this set consists of articles and activities. The articles would seem to be written for 9th grade students as indicated by the readability score. However, the material is packed with knowledge of a new type for the average reader of a science text. The poor pictorial representations and the lack of questions with the text would likely cause reader difficulty. This material may prove useful for the good reader with teacher support, but I am skeptical of its utility for the poorer reader that may be found in the inner city.

Chemistry in the Community (ChemCom)

This project is funded by the American Chemical Society. Materials were developed by a large team of writers and classroom teachers, pilot tested, and then field tested at numerous high schools throughout America. The end result of the project is a high school level chemistry book, **ChemCom**, and a teacher's manual, both of which were published by Kendall/Hunt Publishing Company in 1987. The overall goal of the project was to expose students to chemistry as it relates to societal, industrial, and daily concerns. Theory is only introduced to students in the context of a concrete example of applied chemistry. The curriculum matrix for the **ChemCom** book follows.

GUIDELINES MATRIX FOR CURRICULUM REVIEW

	Degree and Adequacy of Presentation			
General Criteria Area	Min.	Fair	Good	Exc.
Process Skills 1. Emphasizes science process skills in daily urban settings		x		
2. Self-awareness of thinking strategies (metacognation)	x			
3. Written and oral communication skills emphasized, especially those enhancing job prospects		x		
Knowledge Component 1. Concepts from natural and social sciences in urban STS interactions are presented		x		
2. Effects of technological innovations in urban areas	x			
3. Historic African, Caribbean, and Latin American achievement in science and technology	x			
4. Historic American minority achievement in science and technology	x			
5. Urban "tradeoffs" presented		x		
6. Unique contributions of individuals promoted	x			
7. Career opportunities in science and technology presented	x			
Individual and Group Decision-Making 1. Hands-on investigation in local environment	x			
2. Decision-making on local STS issues	x			
Social Awareness and Involvement 1. Urban interdependency fostered	x			
2. Promotes involvement in constructive local action	x			

Discussion

Overall the book came out with minimal ratings in 10 out of 14 categories and fair ratings in the remaining categories. While the materials show a clear focus on applied chemistry related to everyday life, they fail to sufficiently highlight urban life and the kinds of impact that chemistry has upon minority students in urban schools. This is not a condemnation of the materials, but rather an acknowledgement that if the materials are to be used successfully with inner city, minority students the teacher will have to enrich the materials. A flavor of the kinds of topics covered by the materials as they stand can be gained from the Unit Titles: 1.) Supplying our water needs; 2.) Conserving chemical resources; 3.) Petroleum: to build or to burn?; 4.) Understanding food; 5.) Nuclear chemistry in our world; 6.) Chemistry, air, and climate; 7.) Chemistry and health; and 8.) The chemical industry: promise and challenge.

We will focus on the water unit both to illustrate the strengths of the materials as they stand, and to indicate ways in which a urban high school teacher might supplement the materials to provide more suitable contexts for minority learners. The unit on water is split into five parts that looks respectively at water quality; water contamination; a fish kill and its causes; water purification and treatment; and a simulated town meeting dealing with the fish kill surveyed earlier. As they stand, the five parts of this unit provide a student with a clear understanding of many facets of water use. She learns to analyze samples of water using a variety of techniques and to assess the importance of such analyses. A simulation activity is skillfully interwoven throughout the unit that focuses on a real community. This unit could be greatly enhanced by replacing the Riverwood community of the simulation with a real, local environmental water use situation. Getting students out into the community to gather quantitative and qualitative data bearing on water would not only likely enhance student interest but also result in positive impacts upon the local urban environment. Instead of a simulation, the students might find themselves actively involved in the local political process to effect substantial changes in water use within the local situation. The types and amounts of water usage within the local area should also be explored, beginning with water use right within the school environment itself!

The points made about the water unit, hold for the other units within this book. The more that local activities can be substituted for situations far removed from the urban world of the school, the greater student involvement with the materials and the greater chance for increased social involvement in local STS issues. A further point that should be mentioned about the materials is that blacks and other minorities are used as role models within the photographs accompanying the text. Some reading problems that minority students in urban schools are likely to face with this book are detailed below.

READING ASSESSMENT INSTRUMENT

MATERIAL SURVEYED: Chemistry in the Community

	Degree and Adequacy of Presentation			
Criteria	**Min.**	**Fair**	**Good**	**Exc.**
TEXT CONSTRUCTION a. use of headings and subheads			X	
VOCABULARY PRESENTATION a. highlighting the word in some manner		X		
b. proximity of definition to word			X	
c. use of appropriate examples where possible		X		
PICTORIAL/GRAPHIC REPRESENTATION a. clear and uncluttered pictures			X	
b. direct relationship to the concept				X
c. proximity of picture to the text			X	
POSITION OF QUESTIONS IN THE TEXT a. post questions		X		
b. pre-questions				
c. contiguous questions		X		

FRY READABILITY SCORE: 10th to 11th Grade

Discussion

Although this text scored well on all the criteria I used to evaluate texts, I still have some reservations about its usefulness. This is a highly technical text with a great deal of mathematics and formula manipulation. For this reason alone I have misgivings. The size and layout of the text may also present problems to many students that have poor reading skills. In a class of strong readers I would say this text is appropriate. For an inner city student who has reading problems, I would not recommend it.

Science and Technology in Society (SATIS)

The Association for Science Education in Great Britain produced SATIS as free standing lessons that could be inserted into existing O and A level science courses in Britain in the eighties. The lessons found such a ready response from teachers in this country that the American Chemical Society now handles distribution of SATIS materials to U.S. schools. Unfortunately, as of this date the materials have not appeared in an American edition so readers must contend with British examples and British English.

Twenty-three out of the one hundred lessons in SATIS (in ten volumes) appear to possibly relate to the urban environment and/or minority issues. A listing of these lessons is given here by number and title. The curriculum matrix was applied only to this subset of lessons rather than to the entire set of one hundred.

104 - What's in Our Food?
108 - Fiber in Your Diet
203 - Drinking Alcohol
205 - Looking at Motor Oil
208 - The Price of Food
301 - Air Pollution
401 - Fluoridation of Water Supplies
405 - The Label at the Back (clothing fibres)
407 - Noise
408 - Industrial Gases
501 - Bridges
504 - How Safe is Your Car?
507 - Computers and Jobs
701 - Electricity in Your Home
705 - Physics in Playgrounds
803 - The Technology of Toilets
806 - Stress
809 - Ball Games
902 - Acid Rain
903 - What are the Sounds of Music?
904 - Which Bleach?
909 - AIDS
1006 - As Safe as Houses

The curriculum matrix applied to these lessons as a group appears below.

GUIDELINES MATRIX FOR CURRICULUM REVIEW

	Degree and Adequacy of Presentation			
General Criteria Area	Min.	Fair	Good	Exc.
Process Skills 1. Emphasizes science process skills in daily urban settings			X	
2. Self-awareness of thinking strategies (metacognation)	X			
3. Written and oral communication skills emphasized, especially those enhancing job prospects		X		
Knowledge Component 1. Concepts from natural and social sciences in urban STS interactions are presented		X		
2. Effects of technological innovations in urban areas	X			
3. Historic African, Caribbean, and Latin American achievement in science and technology	X			
4. Historic American minority achievement in science and technology	X			
5. Urban "tradeoffs" presented	X			
6. Unique contributions of individuals promoted	X			
7. Career opportunities in science and technology presented	X			
Individual and Group Decision-Making 1. Hands-on investigation in local environment		X		
2. Decision-making on local STS issues	X			
Social Awareness and Involvement 1. Urban interdependency fostered	X			
2. Promotes involvement in constructive local action	X			

Discussion

While ten of the fourteen marks are minimal, the lessons do a good job of relating science process skills to daily urban settings and some hands-on investigation of the local environment is encouraged. Within the group of 23 there is considerable variability in the degree to which the lessons actively involve the student in the urban environment. Some lessons will be described here along with suggestions for the improvement of these lessons to aid minority learners in urban schools. Analogous changes in the remaining lessons are also necessary but it seems pointless to detail these out for the reader ad nauseum.

"Drinking Alcohol" is divided into three parts. Part one explores the amount of alcohol in a drink using quantitative means and encourages students to burn alcohol to demonstrate the amount of energy alcohol contains. Part 2 describes the effect of alcohol on the body from a physiological viewpoint. Part 3 looks at the issue of safe drinking and blood/alcohol levels. Discussion by the class is encouraged throughout the materials but particularly in Part 3. The lesson easily fits into a biology or health education course where prior work has covered ethanol, nerves, absorption and the liver, or related topics. This lesson could be improved in light of the project guidelines by encouraging deeper self-exploration of alcohol use; a visit to a detoxification unit in the local neighborhood; a classroom visit by a former alcoholic who is a minority member of society; surveys of community drinking patterns; and surveys of student drinking patterns both at the high school and lower levels. A useful group project might be the design and implementation of a student centered/created alcohol education program. Discussion should also focus on the relationship between drinking, other drugs, and maintaining a job.

"The Price of Food" consists of two parts. Part 1 is a survey of foods within one's own home in regards to ingredients, cost, price per unit, country of origin, county of processing, etc. The next part asks students to work in groups and using their lists from home to explore the reasons why some food costs more than others. It is suggested in the teacher's guide that having children from different cultural backgrounds in the same group is helpful. Obviously the authors intend that different values inherent with different ethnic groups will emerge in such discussions. This lesson needs to go even further and by empirical evidence address the wide ranging costs of the same product from various types of stores both within the same community and compared to stores in other communities. This should lead to the realization of how urban crime effects the cost of food. This would foster the idea of urban interdependency and promote perhaps local student action in attempts to reverse the deterioration of the neighborhood.

The lesson on "Noise" considers first how noise is measured. Then a brief look at sources of noise in the local environment occurs. Unfortunately this derives primarily from reading rather than empirical investigation. The effect of noise on health is then considered using data from a study undertaken over a six year period near a European airport. Ways to stop or reduce noise are then considered. Finally, the students are encouraged to find out opinions of students and teachers in regards to noise around the school. Once again, this lesson succeeds in bringing students down to the level of a local issue. The lesson could profit from additional attention to the health effects of walkmans and loud "boxes" (rock music is mentioned in passing in the reading); some quantitative measurements of noise in the local environment (suggested in the teacher's guide as an extension activity) - even tape recordings if audiometers are not available; and plotting noise during the course of a day or week. A study of the effects of a large factory or nearby airport might also be feasible as a long term STS project.

The fact that each of these lessons stands alone is a real plus for the urban teacher. It would be reasonably easy to adapt these lessons locally within a school or school district - especially if someone has access to a desktop publishing unit. The range of ideas covered in these 23 lessons could greatly enhance an existing traditional course and provide needed relevance to the local and urban environment if some time is put into local revision. The readability assessment which follows looks at the materials as they stand.

READING ASSESSMENT INSTRUMENT

MATERIAL SURVEYED: Science and Technology in Society

	Degree and Adequacy of Presentation			
Criteria	**Min.**	**Fair**	**Good**	**Exc.**
TEXT CONSTRUCTION a. use of headings and subheads			X	
VOCABULARY PRESENTATION a. highlighting the word in some manner	X			
b. proximity of definition to word	X			
c. use of appropriate examples where possible		X		
PICTORIAL/GRAPHIC REPRESENTATION a. clear and uncluttered pictures	X			
b. direct relationship to the concept		X		
c. proximity of picture to the text	X			
POSITION OF QUESTIONS IN THE TEXT a. post questions	NA			
b. pre-questions				
c. contiguous questions				

FRY READABILITY SCORE: 8th to 11th Grade

Discussion

These materials present some interesting ideas in how to present science and technology issues to high school students. The use of articles as a source of material to read is very well done. Subheadings and headings assist vocabulary presentation. However, the articles are mostly of a technical nature with not a great deal of attention to preparing the reading for the student. This requires the teacher to prepare students at great length for the reading selections. An additional short coming may be in the actual construction of the text with its column presentation. The topics may or may not be of sufficient interest for the student depending on the quality of the teacher's efforts.

Science and Social Issues

The Public Schools of the District of Columbia produced a competency based, behavioral objectives oriented curriculum guide for teachers called "Science and Social Issues" in 1983. An earlier version was written in 1979 and used in some schools on a trial basis. Four high schools presently use the new program and it will be a required course in each of the Washington D.C. public high schools by 1990.

The program consists of seven units: decision making, urban planning-community focus, urban planning-personal focus, food and nutrition, controlling environmental pollution, nuclear energy, and resource management. For each unit the teacher is given a list of objectives and suggested activities to achieve those objectives. Each teacher will, no doubt, develop materials to go along with each unit for themselves. It is important to realize that this approach may lead to some teachers developing an exemplary program in STS education that is in conformity to the suggested guidelines of this project. The curriculum matrix has been applied only to those suggested activities that are within the teacher's curriculum guide.

GUIDELINES MATRIX FOR CURRICULUM REVIEW

	Degree and Adequacy of Presentation			
General Criteria Area	Min.	Fair	Good	Exc.
Process Skills 1. Emphasizes science process skills in daily urban settings				X
2. Self-awareness of thinking strategies (metacognation)	X			
3. Written and oral communication skills emphasized, especially those enhancing job prospects		X		
Knowledge Component 1. Concepts from natural and social sciences in urban STS interactions are presented			X	
2. Effects of technological innovations in urban areas		X		
3. Historic African, Caribbean, and Latin American achievement in science and technology	X			
4. Historic American minority achievement in science and technology	X			
5. Urban "tradeoffs" presented		X		
6. Unique contributions of individuals promoted	X			
7. Career opportunities in science and technology presented	X			
Individual and Group Decision-Making 1. Hands-on investigation in local environment		X		
2. Decision-making on local STS issues			X	
Social Awareness and Involvement 1. Urban interdependency fostered		X		
2. Promotes involvement in constructive local action		X		

Discussion

The guide overall comes out fairly well in our rating scale. Only five guidelines are either absent or minimally present within the materials. This is, no doubt, a reflection of the fact that this guide was produced by an urban school district that daily grapples with many of the problems identified by this Project.

Some examples of strong points within this guide in terms of the examples used or activities suggested are detailed below:

1. an article about high school drop-outs is used to teach problem solving techniques;
2. local areas and urban situations often encountered such as city park about to be bought up for development by a company with increase in local jobs likely; powerful radio signals of a local station are having some impact on local health; chemical plant is polluting the Potomac River- the EPA says it will close it down resulting in halving of the workforce who are mostly blue-collar, semi-skilled workers;
3. mapping one's neighborhood to probe land use; planning a city; a detailed look at the Metrorail system;
4. lots of references to local newspaper stories of recent years covering local STS issues;
5. local transportation lines- primarily buses and the Metro are investigated;
6. D.C. urban planning issues - introducing students to alternative suggestions for city design in the literature;
7. resources listing, especially free pamphlets that teachers can get classroom sets of for a particular unit;
8. enrollment in D.C. schools in studied when considering population issues;
9. stress in urban areas is the focus of one lesson;
10. urban infant mortality rate is investigated;
11. high blood pressure, venereal disease, and rats are three health issues explored;
12. food processing and its effects upon health are considered;
13. development of a nutrition policy for D.C. is the focus activity of one unit.

Some major criticisms of the guide as a whole include the fact that the instructional activities are primarily writing and discussion based; much assembly work is left to the teacher rather than having all such materials already on hand to duplicate or pass out; the questions are fact oriented and focus almost exclusively on recall; there are no operational questions that encourage investigation; and there are no color graphics.

Overall, this guide goes a long way toward providing the kinds of learning experiences that minority students in an urban environment need in science classes. Greater attention to some matters mentioned above and an attempt to develop greater awareness of metacognition and a knowledge component keyed to the guidelines that were not represented in these materials would lead to even more effective learning situations. Any urban school district contemplating the production of a similar guide would do well to consult this guide as a baseline for development.

Reading Discussion

Since this is not student material but a teacher's guide, no assessment was conducted. A few general comments in regards to reading issues can be made. This guide suggests several different and useful ideas. The use of community resources would seem to offer the greatest opportunity for a student to learn from relevant material. The activities that were presented included not just science but also communication and reading skills. This multi-dimensional approach to teaching the material might allow the student to gain what s/he needs to continue to study science. The fact that the materials used topics that city students from Washington, D.C. might encounter in their daily lives increases the likelihood that students from other cities would profit from this curriculum. I would suggest that this guide might be the most viable option from this entire set of surveyed materials for students from the inner city.

The Department of Defense Dependents Schools (DoDDS)

The DoDDS system has produced a set of modules for use within their schools scattered over five continents. Designed primarily for grades 9-12 science classes, the modules have provoked a good deal of interest by developers and STS enthusiasts in several countries. Fifty percent of each module consists of hands-on activities. Students are encouraged and required to collect data from their local areas, perform analyses of suitable complexity, and do something constructive with the results. Some of the modules also include audiovisual materials that enrich and complement the text. Eleven modules are available with the following titles and topics covered:

"Always Room for One More?" (population dynamics)

"Biomedical Technology"

"Energy"

"Extraterrestrial Settlements"

"Maintaining a Healthy Balance" (systems approach to health)

"Living Room" (aspects of the use of human space)

"Too Good to Lose" (species extinction and endangerment)

"Transportation"

"Water and Civilization"

"Your Money, Your Choice" (consumerism)

"Bridging the Gap" (formal decision making)

The curriculum matrix applied to the whole set of modules is below.

GUIDELINES MATRIX FOR CURRICULUM REVIEW

	Degree and Adequacy of Presentation			
General Criteria Area	Min.	Fair	Good	Exc.
Process Skills 1. Emphasizes science process skills in daily urban settings		X		
2. Self-awareness of thinking strategies (metacognation)	X			
3. Written and oral communication skills emphasized, especially those enhancing job prospects			X	
Knowledge Component 1. Concepts from natural and social sciences in urban STS interactions are presented			X	
2. Effects of technological innovations in urban areas		X		
3. Historic African, Caribbean, and Latin American achievement in science and technology	X			
4. Historic American minority achievement in science and technology	X			
5. Urban "tradeoffs" presented		X		
6. Unique contributions of individuals promoted	X			
7. Career opportunities in science and technology presented	X			
Individual and Group Decision-Making 1. Hands-on investigation in local environment				X
2. Decision-making on local STS issues				X
Social Awareness and Involvement 1. Urban interdependency fostered			X	
2. Promotes involvement in constructive local action			X	

Discussion

The DoDDS materials rank fairly high in 9 out of 14 guideline categories. There is little attention on specific minority issues in the modules except for sickle cell anemia and genetic screening which is discussed in the biomedical technology module. Careers are notably absent from the materials. Like other materials already surveyed, these materials would have to be significantly modified in regards to several of the knowledge component guideline statements. Since the materials were produced under funding from the Federal Government, they are in the public domain and can be freely reproduced. An enterprising school district could change at least 20% of the material within the modules and copyright the materials under their aegis. For a urban school district wishing to use these materials with minority students, at least that much editorial change would be involved before these materials would be suitable. Substantial changes in the articles selected for student readings would be necessary given the reading assessment, to which we now turn.

READING ASSESSMENT INSTRUMENT

MATERIAL SURVEYED: Department of Defense Dependents Schools

	Degree and Adequacy of Presentation			
Criteria	**Min.**	**Fair**	**Good**	**Exc.**
TEXT CONSTRUCTION				
a. use of headings and subheads		X		
VOCABULARY PRESENTATION				
a. highlighting the word in some manner		X		
b. proximity of definition to word	X			
c. use of appropriate examples where possible	X			
PICTORIAL/GRAPHIC REPRESENTATION				
a. clear and uncluttered pictures	X			
b. direct relationship to the concept	X			
c. proximity of picture to the text		X		
POSITION OF QUESTIONS IN THE TEXT				
a. post questions				
b. pre-questions		X		
c. contiguous questions				

FRY READABILITY SCORE: 16th Grade Level

Discussion

The sample of materials reviewed was a series of reprinted articles. Given this constraint alone the material would appear to be of little use as it stands to students from an inner-city environment. Two qualifying facts should be noted, however, before these materials are dismissed as irrelevant. The ratio of reprinted articles to other types of text varies considerably from one module to another within this series, so the sample may be somewhat biased. Secondly, other articles written more appropriately for poorer readers, could likely be substituted and remove some barriers to learning. The textual aids were not of any apparent use to the reader who may be experiencing difficulties. Pictorial representations were provided but were not well reproduced since this is not a commercially printed set. The readability of this material was at the 16th grade level, making it inappropriate for high school level studnts because of the word choice and sentence length.

Modular Science/Technology/Society Inc.

A project of the Wausau school district in Wisconsin, these modules are designed for ninth grade students. Six modules cover the following areas: Skills, Food, Air, Water, Sunshine, and Systems. The entire program has been educationally validated in field trials. Local revision of the materials is invited, authorized, and made easy since a computer disk of the entire series can be purchased in lieu or in addition to hard copy. The $300 charge per module is reasonable for school districts who do not wish to reinvent the wheel.

The overall curriculum matrix for the series is as follows:

GUIDELINES MATRIX FOR CURRICULUM REVIEW

	Degree and Adequacy of Presentation			
General Criteria Area	Min.	Fair	Good	Exc.
Process Skills 1. Emphasizes science process skills in daily urban settings		X		
2. Self-awareness of thinking strategies (metacognation)	X			
3. Written and oral communication skills emphasized, especially those enhancing job prospects		X		
Knowledge Component 1. Concepts from natural and social sciences in urban STS interactions are presented	X			
2. Effects of technological innovations in urban areas	X			
3. Historic African, Caribbean, and Latin American achievement in science and technology	X			
4. Historic American minority achievement in science and technology	X			
5. Urban "tradeoffs" presented	X			
6. Unique contributions of individuals promoted	X			
7. Career opportunities in science and technology presented	X			
Individual and Group Decision-Making 1. Hands-on investigation in local environment	X			
2. Decision-making on local STS issues	X			
Social Awareness and Involvement 1. Urban interdependency fostered	X			
2. Promotes involvement in constructive local action	X			

Discussion

It is obvious from the matrix that more careful attention to minority and urban issues would be necessary for these modules to have high utility for urban school districts. This is hardly surprising since the modules were developed for a small town school district. The current content of each module and ways in which the materials might be enhanced by additional activities or topics is in order.

"Skills" looks at measurement problems, graphing and interpretation of data, science and statistics, the language of science, consumer measurement, and observation skills. There is an activity that helps students learn to read an electric meter and a calculation activity to figure out how much paint is needed to paint one's local school. This module could be easily adapted by using urban issues and local environments to provide the data needed for graphing and interpretation and local empirical observations and measurements. Some topics that might be selected for inclusion are estimates of rat populations within the local area; measurement of the amount of garbage produced within the school and/or local neighborhood; simple demographic statistics of the local area; and local traffic patterns or parking situations.

A second module, "Systems", looks at atoms, molecules, crystals, cells, multicellular organisms, complex organisms, population dynamics, predator-prey relationships, and ecosystem interactions. Once again, urban contexts are totally absent but could easily be included by considering such topics as crystalline structure of city buildings; investigation of the school or the neighborhood as a modified ecosystem; consideration of local drug pushers, addicts, and "innocent" community members as a predator-prey relationship; and population dynamics of the neighborhood.

"Water" looks at electrolysis, density, boiling point, solvent, solubility of solids and gases, diffusion, osmosis, transpiration, dew point, humidity, water quality testing, sewage, costs and consumption. Students create a water "budget" for total water use in their local area (unfortunately the way it is presently designed the teacher supplies the data!). Students monitor water use in their home. They observe slides about a sewage treatment plant. These three activities could be easily turned into ones that involve students more directly in their urban environment. A trip to a local sewage treatment plant would certainly be in order. Assessment of water quality within the local area at various chosen sites would be appropriate.

The module on "Air" covers the topics of oxygen content; gas, pressure, temperature, and volume relationships; dust; bacteria; barometric pressure; wind energy; air cells; weather; elementary aerodynamics; wind instruments; and "seeing" sound with an oscilloscope. The study of bacteria and dust in the local area is a real plus in this module. It only needs a social action component to be a high quality STS activity. Energy use within the home is considered when looking at wind energy. Students are asked to calculate how much energy they would have to produce using wind to meet their current energy needs. Some activities that could be profitably added to this module to bring it more in line with project guidelines would be student investigations of airflow around urban buildings; emphysema and related lung disorders in the local area versus national averages; local air pollution problems; and an expansion of the "seeing" sound activity to include urban noise and walkmans.

"Sunshine" looks at properties of light, distance of the sun and its angle in the sky, heat energy and heat exchange, solar energy and biosphere, photosynthesis, respiration, energy flow (using an aquarium), energy loss, energy transfer in grassland and desert ecosystems, solar heating, and solar economics. This module could benefit from the addition of topics such as the albedo effect in the urban landscape, the design of passive solar heating devices for water, etc. for urban homes, bleaching due to the sun's rays, etc.

The remaining module, "Food" considers soil pore space and water holding capacity; soil classification; soil pH; soil, water, and forest management; food preservation; what's in the food; discoloration of fruit; metric cake; hot dog nutrition; vitamin C; value for your money; food calories; t.v. commerical detective; protein-calorie detective; and food pricing. Many of these activities already have marked utility for urban and minority students and only need a little reworking to reflect broader societal concerns. The lesson on hot dog nutrition is particularly good, given that this food is a staple of many an urban teenager's diet. When revising this module for urban students clear attention should be paid to cultural differences in food preferences and nutritional consequences; a more in-depth look at the food system - i.e. from the farm to the local store; and the role of food stamps and the welfare programs of federal and state agencies.

Math-Science Communications

The National Coordinating Center for Curriculum Development's "Minorities in Engineering Project" of the State University of New York at Stony Brook, developed a set of materials called "Math-Science Communications" in 1980. Organized into 20 discrete packets, the overall focus is on how engineering principles relate to many things in the world around us, both natural and man made. The following packets appear to have some utility to this project and have been reviewed as a composite set in the curriculum matrix below: electrical energy in the home; urban fire: science; urban fire: communications; minority contributions I and II; and television: a closer look.

GUIDELINES MATRIX FOR CURRICULUM REVIEW

	Degree and Adequacy of Presentation			
General Criteria Area	Min.	Fair	Good	Exc.
Process Skills				
1. Emphasizes science process skills in daily urban settings	X			
2. Self-awareness of thinking strategies (metacognation)	X			
3. Written and oral communication skills emphasized, especially those enhancing job prospects		X		
Knowledge Component				
1. Concepts from natural and social sciences in urban STS interactions are presented	X			
2. Effects of technological innovations in urban areas		X		
3. Historic African, Caribbean, and Latin American achievement in science and technology	X			
4. Historic American minority achievement in science and technology				X
5. Urban "tradeoffs" presented	X			
6. Unique contributions of individuals promoted				X
7. Career opportunities in science and technology presented			X	
Individual and Group Decision-Making				
1. Hands-on investigation in local environment	X			
2. Decision-making on local STS issues	X			
Social Awareness and Involvement				
1. Urban interdependency fostered	X			
2. Promotes involvement in constructive local action	X			

Discussion

Dry lab activities are the primary mode of presentation although some packets require more active learning and investigation. While the packets orient students to the uses of engineering in the everyday world, they are not focused on STS issues per se in terms of the questions raised and/or the issues explored. The materials do have marked utility in promoting some of the guidelines of this Project, particularly those involving historic American minority achievement in science and technology and career opportunities.

"Electrical Energy Use in the Home" focuses on energy conservation and the use of electrical appliances. Four major points are emphasized as related in the guide:

1. electrical energy is useful because it can be easily converted into other forms of energy;

2. increased consumption of electrical energy means we must re-evaluate resource reserves for the future;

3. energy can be conserved by the individual, and technology can be used to increase efficiency of energy use;

4. all sectors of society are dependent on the energy supply, so energy conservation in the home plays a small but important part in solving the energy problem.

This module needs to be extended to reflect STS educational principles as stated in the S-STS Project guidelines. Some community investigation via surveys could be proposed. A contest for the best design of an energy saving device could be held. The role of state and local governments in energy policy making could be detailed. A focus on public energy assistance programs could also be valuable.

"Urban Fire: Science" is designed to help students understand the scientific concepts of fire and the technology used in fighting fires. Students test for carbon dioxide and determine the ignition temperatures of certain solids and liquids. Burning rates are calculated and information and an activity focus on putting out a fire with carbon dioxide. As it stands, this module does a good job of teaching some basic scientific and technological concepts in regard to fire fighting. It would need to be significantly upgraded to reflect both STS education and the project guidelines. More active investigation within the local environment would have to be encouraged.

The module on "Urban Fire: Communications" takes a look at several actual urban fires. The role of technology in firefighting communications is portrayed using actual transcripts from a major city fire. Fire safety is emphasized in the closing section of the unit. Most of this module could stand, as is, in urban schools. Useful extensions of the module could involve students in developing local community fire watch organizations; arranging a student volunteer program with the local fire department (with a pre-career planning emphasis), in-depth look at the dangers and consequences of arson in the city, and the improvement of fire evacuation plans for various civic buildings and apartment complexes within the local environment.

The first module on minority contributors looks at black Americans. The second module focuses on Hispanics and native Americans. Biographical vignettes of 21 black inventors, engineers, and scientists including Benjamin Banneker, Elijah McCoy, Lewis Latimer, Vance Marchbanks, Charles Drew, and Meredith Gourdine are presented. Two of the engineers are contemporary contributors to engineering. The module on Hispanics and native Americans features engineers almost but reads easier than the first module since actual interviews of present day contributors is the focus. Material from these two modules could very easily and usefully be inserted at relevant points in any STS curriculum that was going to be used in high schools, especially those materials being prepared for school populations most like the contributors who grace these modules.

"Television" is devoted to two main topics: television and its impact on young children and the technology of television. The first topic is explored using some facts, a story featuring a fictitious character, student logging of television ads during children's programming, and student charting of violence in children's television programming. The section closed with some "do's and don't for observing young children" and then asks students to actively observe young children watching television. Section two looks at the technology of color television through readings and a slide-tape show.

This module could find good usage in an urban school, especially if student research were expanded to include large groups of children as subjects. The results would probably be of interest to researchers in this area since the impact of television upon black children and other minorities is underexplored (see Cheek, this volume). Building in extension activities that would promote social action on the part of the students in regards to local television programming for young children would enhance this module.

READING ASSESSMENT INSTRUMENT

MATERIAL SURVEYED: Math-Science Communications

Criteria	Degree and Adequacy of Presentation Min.	Fair	Good	Exc.
TEXT CONSTRUCTION a. use of headings and subheads	X			
VOCABULARY PRESENTATION a. highlighting the word in some manner	X			
b. proximity of definition to word	X			
c. use of appropriate examples where possible	X			
PICTORIAL/GRAPHIC REPRESENTATION a. clear and uncluttered pictures	X			
b. direct relationship to the concept		X		
c. proximity of picture to the text	X			
POSITION OF QUESTIONS IN THE TEXT a. post questions	X			
b. pre-questions				
c. contiguous questions				

FRY READABILITY SCORE: 11th Grade

Discussion

This set of materials is designed, according to the NCCCD, for the preparation of college-bound students for entry into quantitatively oriented higher education. With this in mind, it becomes somewhat easier to understand my misgivings for using the texts in any location where the ability to read might be an issue. Although this material was at the 11th grade on the readability score, its presentation of material is very technical with what appears to be little regard for the student who may not be a strong reader. This program does offer communcations activities and attempts to promote listening and communication skills, but this is not sufficient for a teacher who has students who cannot read at the level required by this set of materials.

Science in a Social Context (SISCON)

SISCON is a British curriculum project that consists of a set of materials designed for high school students. There is a complementary set of materials for college students. Eight individual booklets make up the series:

Ways of Living - a look at environmental issues

How Can We Be Sure? - a look at scientific theorizing and experimentation, the limits of scientific knowledge, and the political and social dimensions of scientific endeavors

Technology, Invention, and Industry - what makes new technologies succeed and case studies of plastics and microelectronics

Evolution - evolutionary theory forms part one, part two looks at moral, medical, and legal dilemmas in genetically handicapped babies

The Atomic Bomb - a look at the Manhattan Project, nuclear proliferation and arms control

Energy - concepts in energy, consumption, and the debate about energy sources and uses

Health, Food, and Population - a look at sanitation, food, infant mortality, immunization in nineteenth century Britain and in the Third World today

Space, Cosmology, and Fantasy - attitudes toward space, cosmology, and the exploration of outer space

While the materials are very "British" in their focus (like SATIS reviewed above), they have been used with adaptation in American schools. Accordingly they are reviewed here as a composite set.

GUIDELINES MATRIX FOR CURRICULUM REVIEW

General Criteria Area	Degree and Adequacy of Presentation Min.	Fair	Good	Exc.
Process Skills 1. Emphasizes science process skills in daily urban settings	X			
2. Self-awareness of thinking strategies (metacognation)	X			
3. Written and oral communication skills emphasized, especially those enhancing job prospects	X			
Knowledge Component 1. Concepts from natural and social sciences in urban STS interactions are presented	X			
2. Effects of technological innovations in urban areas	X			
3. Historic African, Caribbean, and Latin American achievement in science and technology	X			
4. Historic American minority achievement in science and technology	X			
5. Urban "tradeoffs" presented	X			
6. Unique contributions of individuals promoted	X			
7. Career opportunities in science and technology presented	X			
Individual and Group Decision-Making 1. Hands-on investigation in local environment	X			
2. Decision-making on local STS issues	X			
Social Awareness and Involvement 1. Urban interdependency fostered	X			
2. Promotes involvement in constructive local action	X			

Discussion

It is readily apparent that these materials were not intended to meet guidelines like those proposed by this Project, as least on their own. There are a few topics that might be borrowed from these materials to assist in the creation of an STS course. These would include racialism (in **Evolution and the Human Population**); contraception pill, family planning, and birth control (in **Health, Food, and Population**); and water quality, air pollution, recycling, and housing in the city (in **Ways of Living**). Even these sections within the booklets would have to reworked to reflect American contexts. They would also have to be enhanced by hands-on investigation and action activities.

READING ASSESSMENT INSTRUMENT

MATERIAL SURVEYED: Science in a Social Context

Criteria	Degree and Adequacy of Presentation			
	Min.	Fair	Good	Exc.
TEXT CONSTRUCTION a. use of headings and subheads			X	
VOCABULARY PRESENTATION a. highlighting the word in some manner	X			
b. proximity of definition to word		X		
c. use of appropriate examples where possible	X			
PICTORIAL/GRAPHIC REPRESENTATION a. clear and uncluttered pictures		X		
b. direct relationship to the concept		X		
c. proximity of picture to the text		X		
POSITION OF QUESTIONS IN THE TEXT a. post questions				
b. pre-questions				
c. contiguous questions		X		

FRY READABILITY SCORE: 11th Grade

Discussion

A random sample of the booklets provided for student use in this series garnered a Fry Readability score of 11th grade. The booklets make an attempt to use headings and subheadings to clear up ambiguities in the reading. There was evidence that vocabulary words were highlighted in some fashion and that definitions were close to the words themselves. Pictures and other graphic representations were well aligned with what we would want to see in texts for high school students. This set of materials could prove quite useful for inner city students with the teacher providing considerable support.

Preparing for Tomorrow's World

Twelves free standing but interrelated modules were prepared by Rutgers - The State University of New Jersey under the overall project titled "Preparing for Tomorrow's World". They are now available in published form from Sopris West Publishers Inc. in Colorado. Several modules are supplemented with filmstrips designed exclusively for this curriculum. Organized by grade levels for grades 7-12, each module contains a teacher's guide and curriculum model, 10 student guides, a film strip and tape, and 10 copies of required worksheets. The materials were field tested with over 6,000 students. Validation of the results was obtained from the U.S. Office of Education and the materials are available through the National Diffusion Network. They are currently being used in over 200 school districts in 12 states.

The module titles are listed below.

Coastal Decisions

Future Scnearios in Communications

Decisions for Today and Tomorrow

Space Encounters

Technology and Changing Lifestyles

Perspective on Transportation

People and Environmental Changes

Of Animals, Nature, and People

Environmental Dilemmas: Critical Decisions for Society

Beacon City: An Urban Land Use Simulation

Dilemmas in Bioethics

Technology and Society: A Futuristic Perspective

Scenario writing, graphing, conducting surveys, problem solving, and futures forecasting are woven throughout the modules. Discussion and debate are also major features. The composite curriculum matrix for the series is as follows:

GUIDELINES MATRIX FOR CURRICULUM REVIEW

	Degree and Adequacy of Presentation			
General Criteria Area	Min.	Fair	Good	Exc.
Process Skills 1. Emphasizes science process skills in daily urban settings	X			
2. Self-awareness of thinking strategies (metacognation)		X		
3. Written and oral communication skills emphasized, especially those enhancing job prospects			X	
Knowledge Component 1. Concepts from natural and social sciences in urban STS interactions are presented			X	
2. Effects of technological innovations in urban areas			X	
3. Historic African, Caribbean, and Latin American achievement in science and technology	X			
4. Historic American minority achievement in science and technology	X			
5. Urban "tradeoffs" presented		X		
6. Unique contributions of individuals promoted	X			
7. Career opportunities in science and technology presented	X			
Individual and Group Decision-Making 1. Hands-on investigation in local environment	X			
2. Decision-making on local STS issues	X			
Social Awareness and Involvement 1. Urban interdependency fostered		X		
2. Promotes involvement in constructive local action	X			

Discussion

These materials are very good at promoting certain kinds of skills and knowledge central to the guidelines of this project. They are weak in hands-on, local investigation activity (since most of the units feature simulations or STS issues that are national rather than local in scope). Historic contributions of minority members to science and technology and careers in such fields are absent. A nice feature of these materials is that the various activities can be used as discrete units of study or the entire module can be covered. Some useful activities within this set that could be used "as is" in urban schools appears below:

- **Beacon City: An Urban Land-use Simulation** - students role play an STS issue set in an urban coastal community. Proposals for the use of a redevelopment site are developed by students.
- drug experimentation, genetic screening in **Dilemmas in Bioethics.**
- toxic chemicals in **Environmental Dilemmas: Critical Decisions for Society.**
- the changing role of the housewife due to technology in **Technology and Society: A Futuristic Perspective.**
- mass transit and the automobile in the city (in **Perspectives on Transportation**).
- hazardous wastes and robiotics in the factory in **Decisions for Today and Tomorrow**
- saving coastal beaches in urban areas, waste chemicals, polyvinyl chloride on the production line, and sewers and wastewater treatment in **Environmental Dilemmas.**

There is considerable emphasis within the materials on reading activities and it is to that issue we now turn.

READING ASSESSMENT INSTRUMENT

MATERIAL SURVEYED: Preparing for Tomorrows World

Criteria	Degree and Adequacy of Presentation			
	Min.	**Fair**	**Good**	**Exc.**
TEXT CONSTRUCTION a. use of headings and subheads	X			
VOCABULARY PRESENTATION a. highlighting the word in some manner	X			
b. proximity of definition to word	X			
c. use of appropriate examples where possible	X			
PICTORIAL/GRAPHIC REPRESENTATION a. clear and uncluttered pictures	X			
b. direct relationship to the concept	X			
c. proximity of picture to the text	X			
POSITION OF QUESTIONS IN THE TEXT a. post questions		X		
b. pre-questions	X			
c. contiguous questions	X			

FRY READABILITY SCORE: 13th Grade

Discussion

This set of materials is geared for the student who is experiencing little in the way of reading problems. It presents problems to those students who do not have highly developed reading skills. The presentation of the material is very difficult to follow, with the text providing little or no vocabulary aid or any aid in the form of pictorial representations. The utility of this set of materials is determined by the level of skill development of the individual student. I would hesitate to use it in any teaching situation where reading skills of students may be weak.

Concern Regarding the Environment and Technology in our Nation/Neighborhood

This curriculum set was originally developed at LaSalle-Peru Township High School in Illinois. Nationally validated through the U.S. Office of Education in 1979, this curriculum was available through the National Diffusion Network, but is currently out of circulation. High school teachers in over 22 states currently use the materials in science or social studies classes to look at environmental issues. Sixteen modules and related audiovisual materials grouped around four main themes make up the program.

Energy - gasoline, electricity, nuclear power, coal, and solar

Land Use - urbanization and zoning, streets and roads, parks and recreation, and wildlife

Urban Management - solid waste, waste water, and population

Pollution - air, water, noise, rural

Several of these modules relate directly to the urban environment. There are within each module, sections that involve a local problem focus with simple, medium, and advanced application projects for students to select. Clear directions accompany these project descriptions. A composite of the findings for the entire set of materials follows.

GUIDELINES MATRIX FOR CURRICULUM REVIEW

	Degree and Adequacy of Presentation			
General Criteria Area	Min.	Fair	Good	Exc.
Process Skills 1. Emphasizes science process skills in daily urban settings			X	
2. Self-awareness of thinking strategies (metacognation)	X			
3. Written and oral communication skills emphasized, especially those enhancing job prospects		X		
Knowledge Component 1. Concepts from natural and social sciences in urban STS interactions are presented			X	
2. Effects of technological innovations in urban areas		X		
3. Historic African, Caribbean, and Latin American achievement in science and technology	X			
4. Historic American minority achievement in science and technology	X			
5. Urban "tradeoffs" presented		X		
6. Unique contributions of individuals promoted	X			
7. Career opportunities in science and technology presented	X			
Individual and Group Decision-Making 1. Hands-on investigation in local environment				X
2. Decision-making on local STS issues				X
Social Awareness and Involvement 1. Urban interdependency fostered			X	
2. Promotes involvement in constructive local action		X		

Discussion

These materials have marked utility for advancing STS education for minority students in several areas. As mentioned earlier, the focus on local environmental issues within each module is a strong point of these materials. To give the reader a flavor of the kinds of local issues that are explored, examples from five modules will be cited here. For each of these local problems, the student is permitted to choose a simple problem option (works through part of the Problem-Solving Model used throughout the materials); an advanced problem option (working through the entire Model and results in proposing a solution to the local problem); and open-ended problem solving (for experienced problem solvers with little guidance given).

Local Water Pollution Problems

Simple : testing water samples

Advanced: drinking water the pollution

Open-ended problem solving:
polluted rivers
farm erosion
wasted water
road salt
landfill
pollution

Local Problems with Waste Water

Simple: you and your sewage

Advanced: river and lake pollution

Open-ended problem solving:
violations of sewage regulations
rural sewage problems
flooding problems

Local Problems with Electricity

Simple: the waste of electricity

Advanced: local management of electricity

Open-ended problem solving:
sulfur dioxide gas
alternatives to coal-fired electricity
nuclear power

Local Problems with Nuclear Power

Simple: how safe is nuclear power?

Advanced: disposal of nuclear waste

Open-ended problem solving:
nuclear holocaust- survival planning
medical uses of nuclear energy
thermal pollution
radiation sickness
alternate sources of energy
fusion reactor

Local Problems with Population

Simple: population changes at our school

Advanced: population changes in our state

Open-ended problem solving: the issue of birth control
the issue of abortion
local population shifts or growth
our population of pets
your idea

Quite a few of these modules could be used as they stand; some need some additional materials. All could benefit from the inclusion of relevant materials highlighting American minority achievement in science and technology, career opportunities in science and technology, historic non-European achievements in science and technology, and some exercises that promote metacognition.

READING ASSESSMENT INSTRUMENT

MATERIAL SURVEYED: Concern Regarding the Environment and Technology in our Nation/Neighborhood

	Degree and Adequacy of Presentation			
Criteria	**Min.**	**Fair**	**Good**	**Exc.**
TEXT CONSTRUCTION a. use of headings and subheads		x		
VOCABULARY PRESENTATION a. highlighting the word in some manner		x		
b. proximity of definition to word		x		
c. use of appropriate examples where possible		x		
PICTORIAL/GRAPHIC REPRESENTATION a. clear and uncluttered pictures	x			
b. direct relationship to the concept		x		
c. proximity of picture to the text			x	
POSITION OF QUESTIONS IN THE TEXT a. post questions		x		
b. pre-questions		x		
c. contiguous questions	x			

FRY READABILITY SCORE: 8th to 9th Grade

Discussion

Although the topics in this series of modules would appear interesting to the average reader, I am not sure they will catch the eye of an inner city youth. If the topics are appealing then the presentation of articles and reprints of interviews may be problematic. This format does not allow for much in the way of vocabulary development or the use of pictorial representations. It is these shortcomings that may render these materials less than desirable for the inner city student, unless the teacher can find ways to bring the topics into the environment of the city.

Multnomah School District IJ, Portland, Oregon

These materials, like the **Math-Science Communications** analyzed above, were not designed for STS education. The Multnomah School District I-Junior in Portland, Oregon, felt a need to develop greater multicultural awareness on the part of teachers and students within their district. They created a series of five essays for teachers with accompanying lessons for K-5 students, that focused on historic and contemporary black contributions in the areas of science and technology, mathematics, english, social studies, and the arts. Only two of the teacher guides, those for science and technology and mathematics are discussed here. The curriculum matrix was only applied to the these guides.

GUIDELINES MATRIX FOR CURRICULUM REVIEW

	Degree and Adequacy of Presentation			
General Criteria Area	Min.	Fair	Good	Exc.
Process Skills 1. Emphasizes science process skills in daily urban settings	X			
2. Self-awareness of thinking strategies (metacognation)	X			
3. Written and oral communication skills emphasized, especially those enhancing job prospects	X			
Knowledge Component 1. Concepts from natural and social sciences in urban STS interactions are presented	X			
2. Effects of technological innovations in urban areas	X			
3. Historic African, Caribbean, and Latin American achievement in science and technology				X
4. Historic American minority achievement in science and technology				X
5. Urban "tradeoffs" presented	X			
6. Unique contributions of individuals promoted				X
7. Career opportunities in science and technology presented	X			
Individual and Group Decision-Making 1. Hands-on investigation in local environment	X			
2. Decision-making on local STS issues	X			
Social Awareness and Involvement 1. Urban interdependency fostered	X			
2. Promotes involvement in constructive local action	X			

Discussion

These materials obviously are only suitable as resources for the production of high school level STS education materials for minority learners in urban schools. They cannot be used as they stand to advance STS education. Nor can the teacher's guides (essays) be used directly with high school students since they are written at a very high level and in a college academic style.

The teacher's guide on "African and African-American Contributions to Mathematics" consists of an extended essay, footnoted to relevant literature, of key discoveries and developments in mathematics that originated on the African continent. A final section looks at contemporary African-American mathematicians. Most of the mathematical discoveries and techniques covered center on the Ancient Egypt with minor attention to African Muslim mathematicians. The only references to sub-Saharan Africa mathematics is that of "Yoruba numbers and some of the "African Mathematical Games". There are no student activities or questions within this guide.

"African and African-American Contributions to Science and Technology" is also an extended, footnoted essay. Once again Ancient Egypt predominates in the discussion except for an initial look at the African origin of man and attention near the end to the empires of Mali, Ghana, and Songhay in West Africa. Brief mention is made of steel making and ship building in East Africa. The last section of the guide considers black contributions to American medicine and U.S. patented inventions.

Additional work clearly needs to be done in these areas using some of the additional sources discussed in Cheek (this volume). Particular attention on the part of STS curriculum developers should be focused on creative ways to engage minority and other students in replicating key components of some of the scientific inventions/discoveries of blacks both in Africa and in America. This would involve students in hands-on activities in science and technology; create respect for the genius of historic black contributions to science and technology; and promote an awareness of the contributions black Americans can make in these fields within contemporary American society.

Since the teacher's guides and not the elementary curriculum was the focus of this project's analysis of this set, no reading assessment was conducted. It is readily apparent that these two essays are written for college educated individuals.

You, Me, and Technology

This is a series of videotapes designed to supplement existing courses in STS or traditional science, social studies, and vocational education courses in junior highs and high schools. Twelve programs (each twenty minutes in length) make up the set with the following titles and subjects:

Living with Technology (consumerism)

Decisions, Decisions, Decisions (information processing)

The Technology Spiral (four technology revolutions)

Energy for Societies (alternative energy sources)

Health and Technologies (costs and benefits to society)

Feeding the World (agricultural technologies)

Communications: The Expanding World

A Changing Romance: Americans and Wheels (transportation)

China, Japan, and the West (transfer of technology)

Population Patterns (rising birthrate, falling death rate)

Exploring Space (benefits of space exploration)

Risk and Safety (risk in a technological society)

There is a comprehensive teacher's guide that accompanies the videotapes. The guide includes a set of overhead transparencies keyed to the videos, suggested activities, and curriculum matches between this series and science and technology, mathematics, social studies, english, and vocational education classes. The format of each video varies in order to provide variety: some feature a host, some are documentaries, others are dramatizations. There are no formal "lectures" by experts within the materials.

A student guide also accompanies the materials, with three activities for each program. The first is a hands-on laboratory activity. The second involves some library research and a short writing assignment. The third activity involves the student in some type of technological assessment regarding the local environment or the life of an individual student.

To give a flavor of the kinds of material covered in these videos, two programs summaries from the teacher's guide are reproduced below:

Lesson One: Living with Technology

The Manning family deals with the benefits, frustrations, and dangers of technological developments in clothing, communication, transportation, and food processing. Viewers meet Ruth Manning, who travels thousands of mile a day in her business as a management consultant; Ralph, an accountant, carries on his business at home with the help of a computer and modem. Their children, Debbie, 16, and Harry, 18, and Ruth's father, Arnold, who lives with them, deal with technology all day at home and at school. Ralph's hobby of fixing old radios leads to a presentation of the revolution in communications from the time of Andrew Jackson, when news took months to spread to the frontier, to the moon landing with instant communication back to earth. These developments involve trade-offs: noise pollution and the difficulty of distinguishing information from propoganda. Modern transportation, which permits the Mannings to live where they wish, is contrasted with older forms. Greater freedom of movement has also brought greater risks and pollution. Struggling with a faulty vending machine, Debby Manning exemplifies consumers who deal with the effects of highly developed food processing and distribution systems. The program ends by asking, "How free are we in a technological society?" It emphasizes that we must examine trade-offs to make good decisions.

Lesson 12: Risk and Safety

Living with technology is much like riding a motorcycle. The right equipment combined with the knowledge and experience of the rider greatly reduces the risk of danger. Risk is part of life, either voluntary risk, such as skateboarding or air travel, or involuntary risks such as drinking tap water that may be contaminated. The risk of danger we perceive in riding a roller coaster may be quite different from the statistical risk calculated by an insurance actuary. Smoking involves a long-term risk, but driving has the highest short-term risk, especially for 16-24 year olds. Is it the manufacturer's responsibility to prevent the misuse of his product? Simulated crashes with dummies show that seat belts, airbags, and other technology could prevent much death and injury, however, through higher insurance premiums. The 1984 catastrophe in Bhopal, India, when fatal toxic fumes escaped from a chemical plant, showed that staying home is not always safe either. When we build large industrial complexes or nuclear energy plants we may be postponing the risk until later. Humans may not be able to survive the technology they have created unless they learn how to predict and control its negative consequences.

The curriculum matrix was applied to the entire set of videotapes with the following result:

GUIDELINES MATRIX FOR CURRICULUM REVIEW

	Degree and Adequacy of Presentation			
General Criteria Area	Min.	Fair	Good	Exc.
Process Skills 1. Emphasizes science process skills in daily urban settings		X		
2. Self-awareness of thinking strategies (metacognation)	X			
3. Written and oral communication skills emphasized, especially those enhancing job prospects		X		
Knowledge Component 1. Concepts from natural and social sciences in urban STS interactions are presented			X	
2. Effects of technological innovations in urban areas			X	
3. Historic African, Caribbean, and Latin American achievement in science and technology	X			
4. Historic American minority achievement in science and technology	X			
5. Urban "tradeoffs" presented			X	
6. Unique contributions of individuals promoted		X		
7. Career opportunities in science and technology presented	X			
Individual and Group Decision-Making 1. Hands-on investigation in local environment	X			
2. Decision-making on local STS issues	X			
Social Awareness and Involvement 1. Urban interdependency fostered		X		
2. Promotes involvement in constructive local action	X			

Discussion

It can be readily seen that the videotapes alone do not adequately address issues raised by the project guidelines. Since no adaptation of the videotape presentations themselves is possible, it is clear that an urban school district who wished to use this videotape series with their students would do well to produce an accompanying curriculum guide for the teacher that would provide the kinds of material and information that would enhance this program. Whether such enhancement, exterior to the videotapes themselves, would overcome the lack of engagement that minority students in urban schools might feel when viewing these programs can only be determined by field trials of the revised material package.

Summary and Implications

This paper has surveyed twelve programs that are targeted to increase scientific and technological literacy of students. Most of these programs are designated as STS education materials, some are focused on engineering or general science education. One program focuses on elementary levels, all others are intended for middle through high school students. A composite curriculum matrix of these material sets in light of the guidelines for STS education for minority students formulated by this Project follows this page.

SUMMARY MATRIX - STS CURRICULA IN LIGHT OF PROJECT GUIDELINES

Key:
1 - Minimal
2 = Fair
3 = Good
4 = Excellent

General Criteria Area	INNOVATIONS (BSCS)	CHEMISTRY IN THE COMMUNITY (CHEMCOM)	SCIENCE AND TECHNOLOGY IN SOCIETY (SATIS)	SCIENCE AND SOCIAL ISSUES (WASH.,D.C.)	DEPARTMENT OF DEFENSE (DODDS)	MODULAR S/T/S (WAUSAU,WI)	MULTNOMAH SCHOOL (PORTLAND)	MATH-SCIENCE COMMUNICATIONS (MIN. IN ENG. PROJECT)	YOU, ME, AND TECHNOLOGY	SCIENCE IN SOCIAL CONTEXT (SISCON)	PREPARING FOR TOMORROW'S WORLD	CONCERN REGARDING THE ENVIRONMENT & TECHNOLOGY IN OUR NATION/NEIGHBORHOOD (CREATION)
Process Skills												
1. Emphasizes science process skills in daily urban settings	2	2	3	4	2	2	1	1	2	1	1	3
2. Self-awareness of thinking strategies (metacognition) encouraged	1	1	1	1	1	1	1	1	1	1	2	1
3. Written and oral communication skills emphasized, especially those enhancing job prospects	2	2	2	2	3	2	1	2	2	1	3	2
Knowledge Component												
1. Concepts from natural and social sciences in urban STS interactions are presented	2	2	2	3	3	1	1	1	3	1	3	3
2. Effects of technological innovations in urban areas	1	1	1	2	2	1	1	2	3	1	3	2
3. Historic African, Caribbean, and Latin American achievement in science and technology	1	1	1	1	1	1	4	1	1	1	1	1
4. Historic American minority achievement in science and technology	1	1	1	1	1	1	4	4	1	1	1	1
5. Urban "tradeoffs" presented	1	2	1	2	2	1	1	1	3	1	2	2
6. Unique contributions of individuals promoted	1	1	1	1	1	1	4	4	2	1	1	1
7. Career opportunities in science and technology presented	1	1	1	1	1	1	1	3	1	1	1	1
Individual and Group Decision-Making												
1. Hands-on investigation in local environment	2	1	2	2	4	1	1	1	1	1	1	4
2. Decision-making on local STS issues	1	1	1	3	4	1	1	1	1	1	1	4
Social Awareness and Involvement												
1. Urban interdependency fostered	1	1	1	2	3	1	1	1	2	1	2	3
2. Promotes involvement in constructive social action in urban community	1	1	1	2	3	1	1	1	1	1	1	2

It can be readily seen in this matrix that none of the materials surveyed contains sufficient quality and coverage of these guideline principles to be utilized "as is" in urban schools with large minority student populations. Four curriculum material sets (**Science and Social Issues, Department of Defense Dependents Schools, Math-Science Communications**, and **Concern Regarding the Environment and Technology in Our Nation/Neighborhood**) have enough material within them that is sensitive to several guideline statements that they would be useful references for an urban school district attempting to develop appropriate STS materials for their students. Additional help for such a curriculum development effort would be the unit outlines produced within this project (see Weisenmayer, this volume). Nearly all of the materials surveyed have some material that would be of use to further curriculum development efforts. As urban school districts are able to produce material that is more sensitive to the needs of their predominantly minority populations, we should see greater involvement by minority students in learning and in science and technology related careers. There is a critical need for such materials at this very moment and it is hoped that this Project furnishes developers with sufficient information to successfully undertake such development.

Reading issues as they relate to inner city minority youth are insufficiently taken account of by these existing material sets. Any future development of STS education materials for this population of high school students would do well to attend to these issues in some detail so that student learning might not be handicapped at the outset by the design of the materials themselves. Further discussion of this issue is provided in the papers within this project of Cheek and Dupuis.

CURRICULUM MATERIALS SURVEYED

Adams III, Hunter Havelin, African and African-American Contributions to Science and Technology, Multnomah School District IJ, Portland, OR, 1985.

Agency for Instructional Technology, You, Me, and Technology, Bloomington, IN,

American Chemical Society, ChemCom - Chemistry in the Community, Kendall/Hunt Pub. Co., Dubuque, IA, 1988 (student text and teacher's guide).

Association for Science Education, Science & Technology in Society, Hatfield, Herts., 10 vols., 1986, 1988 (available in the USA from The American Chemical Society, Washington, D.C.).

Biological Sciences Curriculum Study, Innovations - the Social Consequences of Science and Technology, Kendall/Hunt Pub. Co., Dubuque, IA, 1981 (5 modules with accompanying teacher guides).

Department of Defense Dependents Schools, Science, Technology, and Society, DoDDS Germany Region, Wiesbaden, West Germany, rev. ed., 1987 (10 modules).

Harbeck, Mary, Ed., Science and Social Issues, Washington, D.C. Public Schools, 1983.

Iozzi, Louis, et. al., Preparing for Tomorrow's World, Sopris West Inc., Longmont, CO, (12 modules).

LaSalle Peru Township Public Schools, Concern Regarding the Environment and Technology in our Nation/Neighborhood, (out-of-circulation, formerly available through the National Diffusion Network).

Lumpkin, Beatrice, African and African-American Contributions to Mathematics, Multnomah School District IJ, Portland, OR, 1985.

Modular - Science/Technology/Society Inc., Modular - Science/Technology/Society, Wausau, WI, 1986 (6 volumes and a teacher's guide).

National Coordinating Center for Curriculum Development - Minorities in Engineering Project, Math-Science Communications, SUNY, Stony Brook,

Solomon, Joan, et. al., Science in a Social Context, Basil Blackwell Ltd., Oxford, England, 1983 (8 titles and teacher's guide).

OTHER REFERENCES CITED

Arnold, D.J., P. H. Brooks, "Influence of contextual organizing material on children's listening comprehension", *Journal of Educational Psychology*, 68: 711-716, 1976.

Cuban, L., *How Teachers Taught*, Longman Pub., New York, 1984.

Graves, M.F., D. L. Clark, "The effect of adjunct questions on low achievers' reading comprehension, *Reading Improvement*, 18: 8-13, 1981.

Levin, J.R., R. Divine-Hawkins, S.M. Kerst, J. Guttman, "Individual differences in learning from pictures and words: the development and application of an instrument", *Journal of Educational Psychology*, 66: 296-303, 1974.

Rasco, R.W., R.D. Tennyson, R.C. Boutwell, "Imagery instructions and drawings in learning prose", *Journal of Educational Psychology*, 67: 1880192, 1975.

Watts, G. H., R.C. Anderson, "Effects of three types of questions on learning from prose", *Journal of Educational Psychology*, 62: 387-394, 1971.

White, R.E., *The Effects of Organizational Themes and Adjunct Placements on Childrens' Prose Learning: A Developmental Perspective*, Doctoral Dissertation, Northwestern University, 1981 (*Dissertation Abstracts International*, 42, 2042a-2043a, 1981).

INFUSING SCIENCE-TECHNOLOGY-SOCIETY (STS) STUDIES INTO URBAN SCHOOL SCIENCE CURRICULUM: A MODEL AND EXAMPLES

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Four levels of STS instruction are outlined below, which have been shown to contribute to learners attaining the superordinate goal of STS education -- to aid citizens in developing the knowledge, skills and affective qualities needed to make responsible decisions on STS issues, and to take actions on those decisions toward issue resolutions (Wiesenmayer, 1988). The four subsequent goal levels, as presented by Rubba and Wiesenmayer (1985) are: Level I, the STS Foundations Level; Level II, the STS Issue Awareness Level; Level III, the STS Issue Investigation Level; and Level IV, the STS Action Skills Development Level.

STS curriculum and instruction at Level I, the STS Foundation Level, would provide learners with sufficient background knowledge: a) of concepts in the natural sciences and social sciences and b) on the nature of science, technology, and society, to enable them to make informed decisions on STS issues. Natural science concepts which cut across the respective earth, biological and physical science disciplines, such as those presented by Showalter (1974) (e.g., change, field, interaction, model, system), would be candidates for this study. The effects of society upon the natural environment and the effects of the environment upon society would be examined.

Social science concepts from anthropology, economics, political action, psychology and sociology (e.g., attitude, behavior, institution, culture, social structure, ethics, society resources) would be studied to develop learners' understanding of our social system and to view themselves as interdependent members of this society.

At this level, students would also develop an understanding of the nature of science and technology, their similarities and differences, as well as become cognizant of the typical interactions which occur among science, technology and society.

At Level II, the STS Issue Awareness Level, learners would become cognizant of how the interactions between Science, Technology and Society sometimes result in issues which must be resolved by examining a) all sides of the issue, b) human values, beliefs and ethics, c) alternate solutions for resolving issues and then by d) taking action. A major thrust at this level would be to promote an understanding of the effects of factors such as religion, politics, economics and personal interest on the way STS issues are viewed. Learners would be made aware of the complexity of STS issues, the impact of these issues and possible alternative solutions, and the need for responsible individual and group actions.

Instruction at Level III, the Issues Investigation Level, would develop in learners the knowledge and skills necessary to investigate STS issues and judge the efficacy of possible solutions against various value positions. STS education directed at Level III would have two components. The first would encompass training with problem solving and problem investigation skills, e.g., problem identification and statement, use of secondary sources, data collection via primary sources, data interpretation, drawing conclusions. The second component comprises the opportunity for learners to apply these skills in the investigation of STS issues to increase their confidence in using and understanding quantified scientific information.

At Level IV, STS Action Skill Development Level, STS education would seek to develop in learners skills which they could use, working individually or in groups, and to take action on STS issues. This again would include instructional activities designed to develop an understanding of actions which fall into one of five categories, i.e., consumerism, legal action, persuasion, physical action, and political action and the opportunities to apply these and evaluate their effectiveness in resolving STS issues.

An Urban STS Curriculum Model

STS instruction designed to aid students in developing the knowledge, skills, and affective qualities needed to make responsible decisions on STS issues, and to take actions on those decisions toward issue resolutions must address all four of the STS goal levels cited above (Wiesenmayer, 1988). Research efforts by Hungerford et al. (1980), Klinger (1980), Ramsey et. al. (1981), Hines (1984), and Sia (1986) support this view. These studies suggest that merely identifying STS issues and discussing resolutions are inadequate for PROMOTING responsible citizenship behavior. STS instruction must include investigations and action skill development.

Therefore, the curriculum model described below addresses all for of the STS Goal Level cited above. This model has been field tested with students and teachers in several urban settings.

Before students can begin studying issues related to science and technology, certain prerequisite knowledge is required. This prerequisite knowledge is addressed in the STS Foundations section diagrammed in the STS Curriculum Model Flow Chart found in the next section of this document. As shown in this diagram, students need a comprehensive understanding of what science is and what science is not, and what technology is and what technology is not. Students frequently use the terms science and technology interchangeably and maintain very naive notions about science and technology. Therefore, instruction must be delivered to detect and resolve any misconceptions about science and technology held by students as well as develop clear and accurate conceptions about the nature of science and technology.

Students also need a comprehensive understanding of what society is and what society is not. Although students have been members of a society since their birth, they typically have little understanding of the factors that shape their society i.e., human values, beliefs, ethics, religion, politics, economics, etc. Nor do students understand that the factors that shape their present day society vary with time and geographic region. That is, the factors that shape present day society in their community today, are quite different than those of 200 years ago and quite different from present day societies in the bush country of Africa, the jungles of Brazil, and the backcountry of Australia.

The relationships between science, technology, and society must also be developed in learners prior to studying STS issues. These interrelationships are generally not well established in students cognitive schema. Many students (and teachers) visualize a simple linear relationship between science, technology, and society whereby discoveries in science lead to technological applications which produce certain effects on society. An alternate linear view suggests that society makes demands on technology and these lead to scientific innovations. These naive conceptions about the interrelationships between science, technology, and society must be challenged by instruction aimed at building on the students' present knowledge, creating a more satisfactory model which accounts for a greater number of interactions. The STS Foundations section of the STS curriculum Model Flow Chart depicts science affecting technology and society, technology affecting science and society, and society affecting science and technology.

After students have developed clear and accurate concepts about science, technology, and society and the interactions that exist among them, relevant issues related to science and technology must then be selected. A systematic approach for selecting STS issues is presented in the STS Curriculum Model Flow Chart found below. According to the flow chart, issues under consideration must first be clearly spelled out. Issues such as AIDS, ozone depletion, and the greenhouse effect need to be carefully defined. Generally, there are not people for AIDS and people against, people for ozone depletion and people against ozone depletion, people for the greenhouse effect and people against the greenhouse effect. Therefore, the scope and nature of the issue to be studied must be clearly described. Once the scope and nature of the STS issue has been delineated, several criteria must be considered before selecting an issue for study. First, the issue must be of interest to the students and perceived as important. Critical issues such as the loss of farmland and desertification may be important to study may but not be of interest to inner city minority students.

Secondly, the issue must impact the students. Issues such as killer bees and and sex changes may be of interest to the students and perceived as important, but they are issues that will probably not impact many inner city students.

Thirdly, issues such as nuclear war and genetic engineering may be of interest to the students and perceived as important, and impact the students. However, these are issues that students' day-to-day activities generally do not influence. These issues also are not ones in which the students will be able to experience a great deal of accomplishment for their efforts toward the issues' resolutions.

It is recommended that INITIALLY the issues selected 1) are of interest to inner city minority students, 2) are perceived as important by these students, 3) impact the students directly, 4) are influenced by inner city minority students' day-to-day actions, and 5) are such that the students can modify their own behaviors to make a contribution to the resolution of the issue.

Once an STS issue is selected, students must have a clear idea of what aspect of the issue they are going to study and why it is important. Procedures for accomplishing this are cited in the Issue Awareness section of the Curriculum Model Flow Chart. If the issue to be investigated for example is ozone depletion, is the class going to examine all factors worldwide that deplete the ozone or those factors only in the US? Are they going to be concerned with natural and synthetic chemicals that deplete the ozone? Many classes may want to restrict their inquiry to what they and other people in their community do that depletes the ozone. It is important that the scope and nature of the issues is clearly identified. Also, keeping the scope of the issue restricted to the personal and community level may make the issue investigation more relevant.

The next step, as indicated by IIB in the Curriculum Model Flow Chart, is for the teacher to have the students present their ideas about how science, technology, and/or society may have influenced the development of the issue. Students may be able to cite scientific discoveries such as freon and CFCs, technological developments such as air conditions and styrofoam, and social values of comfort and convenience as some examples of how science, technology and society have fostered the development of the ozone depletion issue. Students may also cite erroneous examples as well. The incorrect examples are valuable to the teacher to identify misconceptions held by the students which can remediated by additional instruction. The intent of having students identify their perceptions of how science, technology and society have fostered the development of a given issue is to help the teacher identify what the students already know about the issue and what misinformation they posses. Both are important!

Concepts related to science, technology, and society that students must possess to make decisions about the issue are then identified by the teacher as noted in IIC in the Curriculum Model Flow Chart. Science concepts such as molecular bonding, polymers, and radiation; technologies such as distillation refrigeration; and social concepts related to economics and human values are examples of concepts teachers might identify when studying ozone depletion.

The final step at the Issue Awareness Level is IID in the Curriculum Model Flow Chart. Here, students identify the various opposing viewpoints of the STS issue. For the ozone depletion issue, opposing viewpoints students might identify are as follows: those who think the ozone is being depleted VS those who don't think the ozone is being depleted; those who think humans are responsible for the ozone depletion VS those who think the ozone depletion is do to natural causes; those who think the ozone depletion is due to CFCs VS those who don't think CFCs deplete ozone: etc. For each viewpoint, the students then identify the various values, beliefs and factual evidence associated with each of the opposing viewpoints.

To begin the Issue Investigation stage (section III in the STS Curriculum Model Flow Chart, the students construct a well formed statement of the issue to be investigated. This statement specifically describes the parameters of the issue to be investigated. Next, the students and teacher design investigations to 1) provide students with the knowledge and skills needed to verify or reject their preconceptions presented in the Issue Awareness section, and 2) to eventually make responsible decisions to help resolve the issue.

To thoroughly investigate an issue, both primary and secondary sources of information must be utilized. Secondary sources can be used to establish the values, beliefs and factual evidence used by the opposing viewpoints. Primary investigations are needed to develop science concepts related to the issue that are not clearly understood and to collect additional information. With the ozone depletion issue, secondary sources can supply students with information presented by scientist, industry, and special interest groups. Primary natural science investigations can help students better understand chemical bonding, atmospheric layers, and lightwaves. Primary social science investigations can collect information about the number of products they and other members of their community consume that my harm the ozone. Peoples' attitudes and beliefs can also be surveyed using primary social science investigations.

The data collected by the investigations are carefully analysed and interpreted by the students and teacher; conclusions are drawn and inferences made. The students are then in a position to predict consequences based on their findings and make recommendations. Finally, the results of their investigations are communicated to the other members of the class or school.

In completing this process, the students have developed and utilized science process skills to investigate a problem of interest and importance to them. The utility of science process skills may then be seen as important and relevant to the inner city minority students rather than something only scientists in laboratories use.

After the investigations have been completed, the students then begin planning ways they can help resolve the issue. The processes for accomplishing this are show in section IV of the STS Curriculum Model Flow Chart.

To begin the STS Action Skill Development stage of the unit, the students identify alternative ends toward which the issue being studied might be resolved. Examples for the ozone depletion issue might be 1) boycott any products sold in styrofoam containers, 2) persuade the principal to eliminate styrofoam products in the cafeteria, and 3) lobby city council members to pass legislation prohibiting car service centers from discharging freon into the atmosphere.

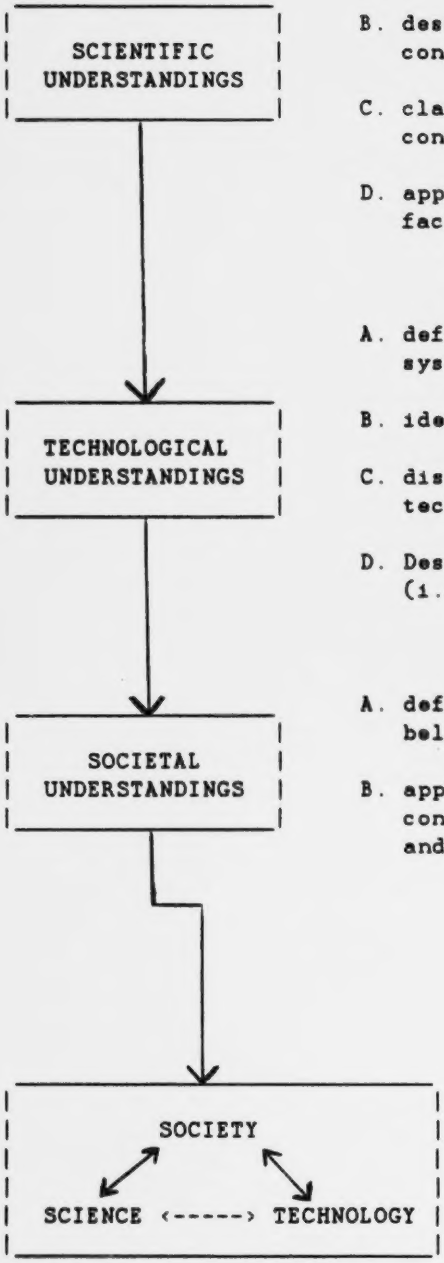
Once the alternative ends have been identified, the students then determine the pros and cons associated with each alternative end. They must also determine the consequences that might arise from the implementation of each alternative end. Boycotting products sold in styrofoam containers might help cut down on some of the pollutants that harm the ozone but it may also mean giving up your favorite hamburger which comes in a styrofoam box.

After determining the pros and cons and consequence associated with each alternative end, the students (individually or in groups) determine which alternative end is most desirable. Next, they identify a variety of action plans to achieve the end selected. If the students studying ozone depletion determined that persuading their principal to eliminate the use of styrofoam products in the cafeteria was the most desirable alternative end, they would design actions plans to accomplish that end. One action plan might be to send a letter to the principal signed by each member of the class. Another action plan might be to organize a Brow Bag lunch day in which students would not buy their lunches from the cafeteria. Next, the consequences of each action plan must be carefully considered.

After carefully considering the consequences of each action plan, the students (individually or in groups) pick the action plan that is the most desirable and implement it. Following the implementation of the action plan, the students assess the effectiveness of their actions taken and modify their action plans if necessary.

An STS Curriculum Model Flow Chart

I. STS Foundations



Students should be able to...

A. state a definition of science which characterizes it as an empirical inquiry process.

B. describe the nature of scientific laws, theories, concepts, and "factual" statements.

C. classify scientific explanations as: laws, theories, concepts, or facts.

D. apply nature science laws, theories, concepts, and facts in problem solving situations.

A. define technology in terms of a socio-technical system of use.

B. identify examples of technological developments.

C. distinguish between examples of science and technology.

D. Describe the characteristics of technology (i.e., costs/benefits, potential/limitations).

A. define a society in terms of peoples' values, beliefs, attitudes, religion, politics etc.

B. apply basic social science laws, theories, and concepts from anthropology, economics, psychology, and sociology as they impinge upon STS issues.

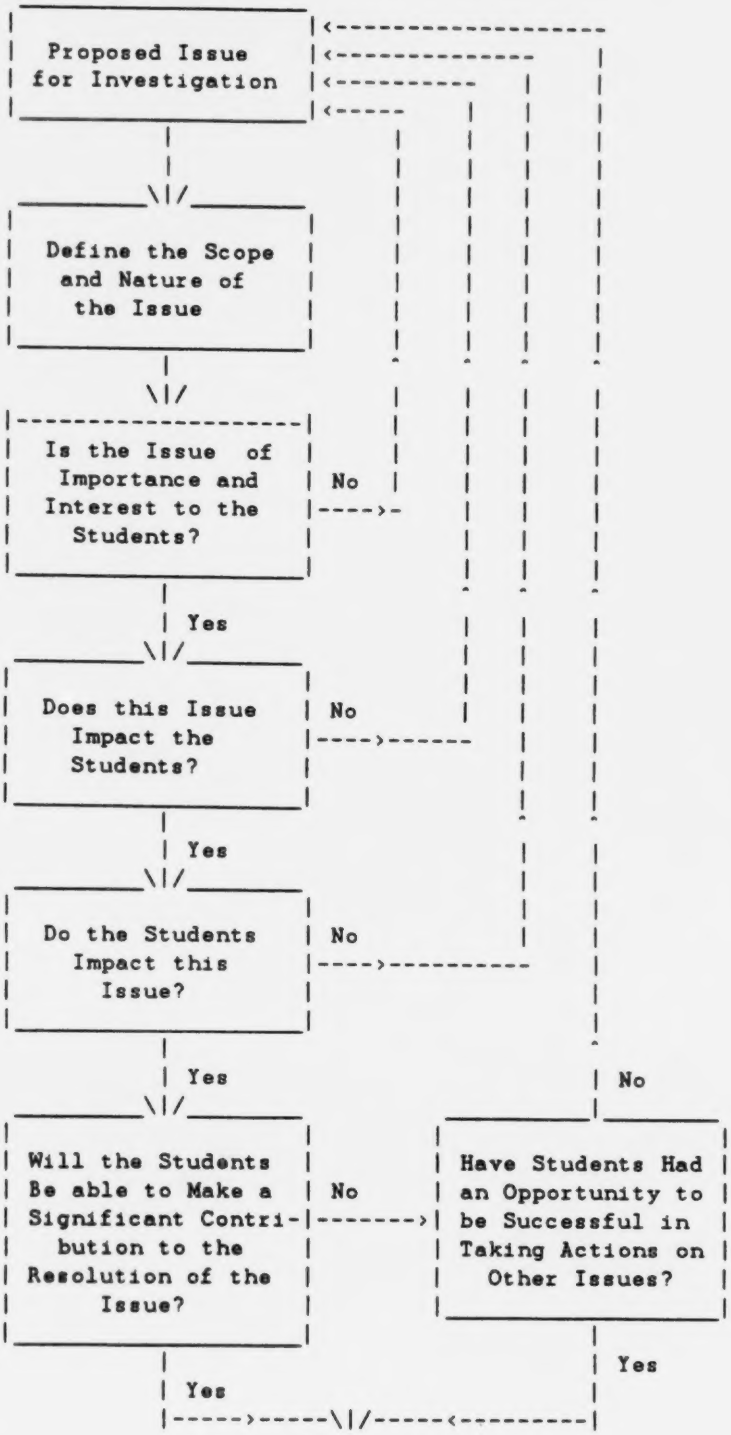
A. describe the characteristic relationships that exist among science, technology, and society.

B. name examples of the interaction between science and technology, and describe the nature of the interaction.

C. name examples of the interaction between science and society, and describe the nature of the interaction.

D. name examples of the interaction between technology and society, and describe the nature of the interaction.

II. ISSUE SELECTION


Proposed Issue for Investigation
Define the Scope and Nature of the Issue
Is the Issue of Importance and Interest to the Students?
No
Yes
Does this Issue Impact the Students?
No
Yes
Do the Students Impact this Issue?
No
Yes
Will the Students Be able to Make a Significant Contribution to the Resolution of the Issue?
No
Yes
Have Students Had an Opportunity to be Successful in Taking Actions on Other Issues?
No
Yes

III. Issue Awareness

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                           _____________________     --A. Focusing Questions
                          |                     |   |  1. What is the scope
                          |  Issue Identified   |---      and nature of the
                          | for  Investigation  |         problem?
                          |_____________________|      2. Why is it impor-
                            /        |        \           tant to study?
B. Impacts on              /         |         \       3. What component(s)
   the issue.             /          |          \         of the issue
                         /           |           \        should be studied?
                     |---------| |------------| |---------|
                     | Science | | Technology | | Society |
                     |_________| |____________| |_________|
                          |            |              |
                          |            |              |
                      ____|___    _____|_____     ____|____
C. What concepts     |        |  |           |  |          |
   must students     |1._____ |  |1._________|  |1.________|
   understand for    |2._____ |  |2._________|  |2.________|
   this issue?       |3._____ |  |3._________|  |3.________|
                     |________|  |___________|  |__________|
                          |            |              |
                          |----->------|------<-------|
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D. What are the op-              |---<---|
   posing viewpoints?            |
                                \|/
        ___________________________________________________
       | Opposing  |            |            |   Factual   |
       | Viewpoints|   Values   |   Beliefs  |   Evidence  |
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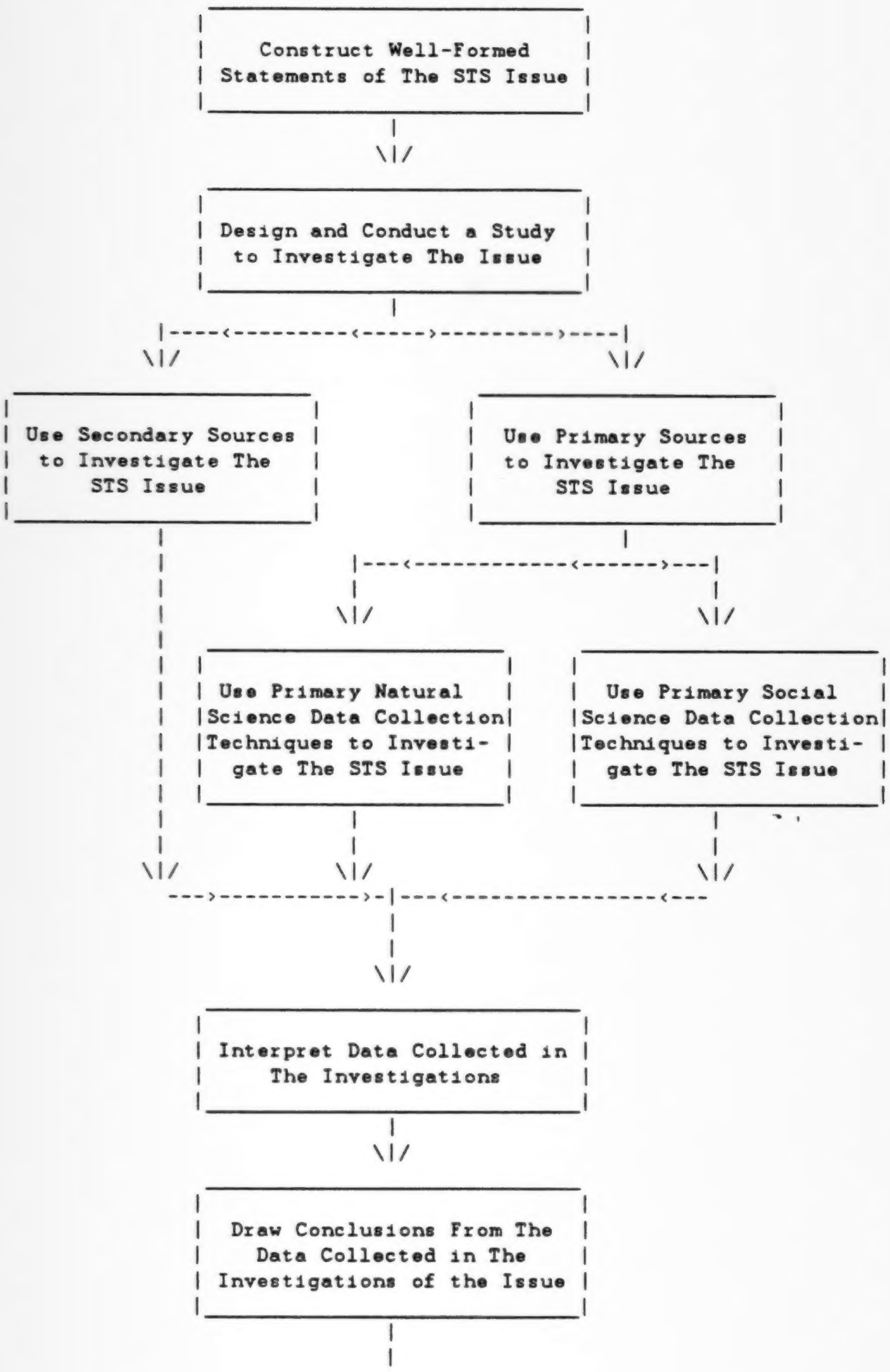
IV. Issue Investigations


Construct Well-Formed Statements of The STS Issue
Design and Conduct a Study to Investigate The Issue
Use Secondary Sources to Investigate The STS Issue
Use Primary Sources to Investigate The STS Issue
Use Primary Natural Science Data Collection Techniques to Investigate The STS Issue
Use Primary Social Science Data Collection Techniques to Investigate The STS Issue
Interpret Data Collected in The Investigations
Draw Conclusions From The Data Collected in The Investigations of the Issue

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 |                                   |
 |   Make Inferences  From The       |
 |     Data Collected in The         |
 | Investigations of the Issue       |
 |___________________________________|
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 |                                   |
 |  Predict Consequences From        |
 |   The Findings of The STS         |
 |    Issues Investigation           |
 |___________________________________|
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  ___________________________________
 |                                   |
 |  Make Recommendations For         |
 |  Couses of Action on The          |
 |  STS Issue Based Upon The         |
 |  Investigation Findings           |
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 | Communicate The Results of        |
 | The Investigations via Oral       |
 |    or Written Reports             |
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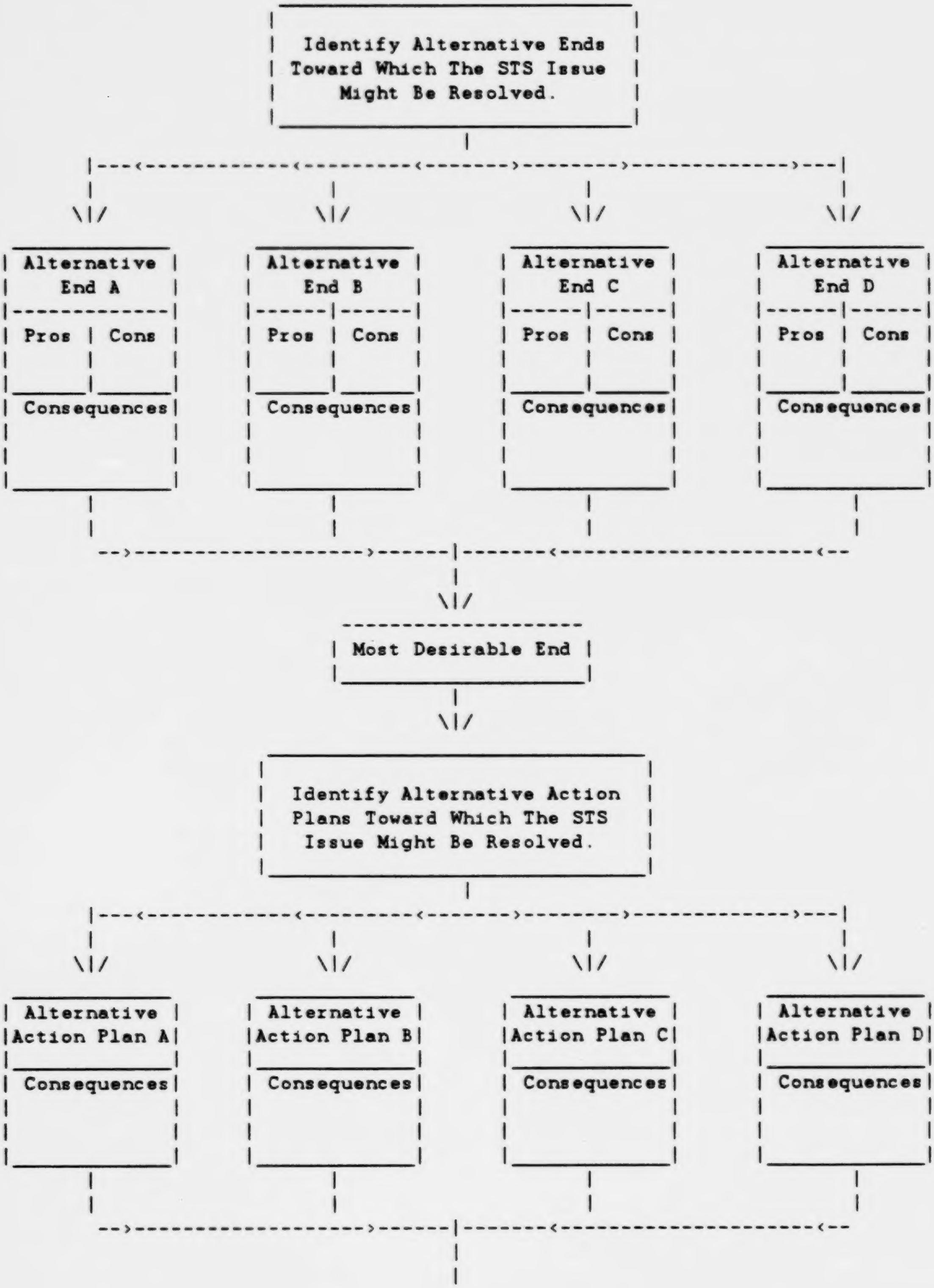
V. STS Action Skill Development


Identify Alternative Ends Toward Which The STS Issue Might Be Resolved.
Alternative End A
Pros
Cons
Consequences
Alternative End B
Pros
Cons
Consequences
Alternative End C
Pros
Cons
Consequences
Alternative End D
Pros
Cons
Consequences
Most Desirable End
Identify Alternative Action Plans Toward Which The STS Issue Might Be Resolved.
Alternative Action Plan A
Consequences
Alternative Action Plan B
Consequences
Alternative Action Plan C
Consequences
Alternative Action Plan D
Consequences

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         |   Most Desirable   |
         |    Action Plan     |
         |____________________|
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         |  Implement Action  |
         | Plan on a Group or |
         |  Individual Basis  |
         |____________________|
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      ---------------------------
     | Assess The Effectiveness  |
     | of Actions Taken Toward   |
     |  The Resolution of The    |
     |        STS Issue.         |
     |___________________________|
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         | Modify The Action  |
         | Plan Based Upon an |
         | Assessment of Its  |
         |   Effectiveness.   |
         |____________________|
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EXAMPLE I

AN OVERVIEW OF

"STS: A UNIT FOR EXPLORING TRASH DISPOSAL"

The STS unit for exploring trash is designed to help students better understand important concepts and issues that impact trash disposal, and to enable students to help resolve the trash disposal issues in their community. This unit is only one example of an STS unit developed to address an urban problem related to science and technology.

The instruction provided to the students in this STS unit addresses the four goal levels cited above: Level I, the STS Foundations Level; Level II, the STS Issue Awareness Level; Level III, the STS Investigation Level; and Level IV, the STS Action Skills Development Level. The STS unit is designed to be delivered over a period of 20 school days (assuming one 45 minute period per day). An overview of the activities for each goal level is provided below.

Level I, STS Foundations

The instruction at Level I, the STS Foundations Level constitutes the first three class periods of the unit. These activies are generic in nature and provide prerequisite knowledge needed to examine most STS issues.

The STS Foundations instruction provide learners with an understanding of the nature of science and technology, their similarities and differences, and the typical interactions that occur among science, technology and society.

Addresses that portion of the Guidelines for STS Education for Inner City Youth in #2.1 which states to "provide learners with sufficient knowledge of...the interactions between science and society to enable them to make informed decisions on STS issues" and is linked to S-STS goals 2 and 7.

Lesson Plan #1. The first lesson at the STS Foundations Level, is designed to help students understand that society affects science by determining the amount of money that is spent on science research and the areas in which research is focused. For this activity, the students are divided into legislative "finance committees" and appropriated a budget of $20 billion dollars for science research. The students must decide how much of the budget to spend in each of the seven areas designated for research. The students are then presented with the figures that the U.S. Congress spent in each of those areas for comparison. The students discuss the differences between their budget and Congress's budget and who they could contact in Washington about changing the amount of money spent in each of the categories.

Addresses that portion of the Guidelines for STS Education for Inner City Youth in #2.1 which states to provide learners with sufficient knowledge to be able to differentiate between science and technology.

Lesson Plan #2. The second lesson at the STS Foundations Level, is designed to help students better differentiate between science and technology. A list of scientific discoveries is generated from the students to develop a definition of science. A series of overheads and a video are employed to develop a broader definition of technology. Following instruction, a list of examples of science and technology is presented to the students for classification.

Addresses that portion of the Guidelines for STS Education for Inner City Youth in #2.1 which states to "provide learners with sufficient knowledge of...the interactions between science and technology to enable them to make informed decisions on STS issues" and #3.2 which states to "foster an understanding that all technologies have costs and benefits ...", and is linked to S-STS goals 1 and 2.

Lesson Plan #3. On the third treatment day, the last day at the STS Foundations Level, a lecture presents many of the relationships that exist between science and technology. Next, the students read a short story entitled "Why We Have Walkmans" which discusses how society affects technology and answer questions concerning what technologies should society try to develop, and what technologies should society suppress. The students are provided with a short story to read for homework for which they are to circle examples of technologies the person in the story used.

Level II, STS Issue Awareness

Three class periods, unit days four through six, are devoted to Level II, the STS Issue Awareness Level, examining the origins of STS issues, their opposing views, alternate solutions, and the need for responsible citizenship action. As with the STS Foundations lesson plans, these these action plans are also generic in nature and provide prerequisite knowledge to examine most STS issues.

Addresses Guidelines for STS Education for Inner City Youth #4.1 which states to "assist students to utilize knowledge and experiences of urban living to identify community STS issues ..." and #4.2 which states to "encourage students to describe their thinking processes in reaching decisions on STS with a view toward improving their higher order thinking skills".

Lesson Plan #4. During the first class at Level II, the students identify social issues they perceive as important. First, each of the issues are classified by the students as an "STS" or "not an STS" issue. Second, a definition of an STS issue is developed. Third, the students then classify each of their issues according to its level of significance, i.e., local, national, or global. Finally, the students prioritize the issues in terms of their importance, and share the results with classmates.

Addresses Guidelines for STS Education for Inner City Youth #2.4 which states to "emphasize the effects of technological innovations in urban areas and on minority communities within the city" and #4.3 which states to "promote an understanding that STS issues are perceived differently by individuals based upon their different backgrounds", and is linked to S-STS goal 2.

Lesson Plan #5. The second day of the STS Issue Awareness Level, students identify ways in which science, technology, and society have influenced a social issue (pollution). Next, a film entitled "The Energy Connection" is viewed that addressed the issue. After the film, students discuss additional ways in which science, technology and society have impacted the issue of pollution. For homework, the students are asked to complete a questionnaire which solicited their view about what science, technology, and society could do to help resolve the issue of pollution.

Lesson Plan #6. On the third day of Level II, the students play a modified version of "Wheel of Fortune". The game is played much like the television version, however, the questions come from their homework assignment. The activity is designed as a review for the STS Issue Awareness Level.

Level III, STS Issue Investigations

For Level III, the STS Issue Investigation Level, eight class periods (unit days seven through fourteen) are needed for students to: 1) design and conduct natural and social science investigations, 2) collect and analyze data, and 3) make inferences, draw conclusions and make recommendations concerning an STS issue (trash disposal) in their community.

Addresses Guidelines for STS Education for Inner City Youth #2.3 which states to "encourage students to undertake hands-on scientific investigations that relate directly to their day-to-day experiences in their personal environments.

Lesson Plan #7 The students sort through bags of trash provided by the teacher on the first day at Goal Level III, treatment day seven, to examine the different kinds of items that are discarded. A graph is constructed to show the percent of trash that is paper, glass, plastics, etc. Next, the teachers and students develop a trash survey to determine the contents of the students' trash at home.

Lesson Plan #8. The second day at Level III focuses on organizing and analyzing the data collected from the students homework assignment. The amounts and kinds of trash

Addresses Guidelines for STS Education for Inner City Youth #2.4 which states to "emphasize the effects of technological innovations in urban areas and on minority communities within the city" and is linked to S-STS goal 8.

Addresses that portion of the Guidelines for STS Education for Inner City Youth in #2.1 which states "provide learners with sufficient knowledge of concepts in the natural sciences...".

Addresses that portion of the Guidelines for STS Education for Inner City Youth in #2.1 which states "provide learners with sufficient knowledge of concepts in the natural sciences...".

Addresses Guidelines for STS Education for Inner City Youth #2.2 which states to "emphasize the use of scientific process skills that can be applied within the context of STS issues and in students' daily lives", and #2.3 which states to "encourage students to undertake hands-on scientific investigations that relate directly to their day-to-day experiences in their personal environments", and is linked to S-STS goals 6 and 8.

Addresses Guidelines for STS Education for Inner City Youth #2.4 which states to "emphasize the effects of technological innovations in urban areas and on minority communities within the city" and is linked to S-STS goal 2.

are graphed on the board and the results discussed. Since the students do not typically know what happens to the trash they generate, their assignment is try to discover where their trash goes.

Lesson Plan #9. When the students come to class on the third day at Level III, they discover that the trash they produce is shipped to a landfill. The teacher leads a discussion about landfills to determine what prior knowledge students have of this method of trash disposal. The teacher explains that a landfill is a large hole dug into the ground and notes some environmental concerns associated with this technology. A lab activity is conducted to examine percolation rates of different types of soils.

Lesson Plan #10. Day four of the investigations is designed to show students first-hand how landfills are built. Using authentic materials, the students construct a model landfill and discuss some advantages and disadvantages to this method of trash disposal.

Lesson Plan #11. The fifth day of the investigations is used to develop a questionnaire/ opinionnaire about the trash problem in their community. The students identify the information that needs to be collected, and the questions required to gather it. The students practice administering the questionnaire/ oppinionnaire with their peers, and then are assigned to administer the survey to at least two adults. The results of the surveys are tallied by the teacher and returned to the students.

Lesson Plans #12 & 13. On the sixth and seventh days of investigations, the students set up lab activities to learn about osmosis and diffusion respectively. The students work in small groups on both days. They record their observations and then present them in a large group setting. The implications of these activities for landfills are discussed.

Lesson Plan #14. A play, "Throwaway Three" (Bradley, 1980), is read on the final day at Level III, which presents an historical perspective about the generation of trash. Starting with early humans and

Addresses Guidelines for STS Education for Inner City Youth #3.3 which states to "demonstrate how individuals with an understanding of science, technology, and their impact on society, can make a positive contribution to the urban environment through careers and community involvement", #4.2 which states to "encourage students to describe their thinking processes in reaching decisions on STS with a view toward improving their higher order thinking skills".
and #4.4 which states to "promote for students the realization that they are unique individuals with personal resources and their personal contributions on STS issues are important for all", and is linked to S-STS goal 4 and 8.

proceeding to present day, the play examines the amount and kinds of trash people have produced.

Level IV, STS Action Skills Development

The final six days of the STS unit are directed at Level IV, the STS Action Skills Development Level. These class periods concentrate on providing students with the skills necessary to take action on STS issues, individually or in groups.

Lesson Plan #15 The first day of instruction at Level IV is designed to have students identify alternative ends toward which their STS issue could be resolved, and examine the pros and cons associated with each end. After several alternative ends are identified, task forces of three to four students each are assigned to research and report on one of the alternative ends.

Addresses Guidelines for STS Education for Inner City Youth #5.1 which states to interweave instructional activities which explore career opportunities that rely on science and technology backgrounds, especially within the urban environment".

Lesson Plan #16. The following day is spent concluding the research and developing reports addressing the consequences of each of the alternative ends identified. A presentation is made near the end of the class period by each group on their assigned alternative end.

Addresses Guidelines for STS Education for Inner City Youth #4.2 which states to "encourage students to describe their thinking processes in reaching decisions on STS with a view toward improving their higher order thinking skills".

Lesson Plan #17. On the third day at Level IV, the students assign priority to the various ends toward which the issue might be resolved, and justified the assigned priority. The student priorities are presented by a group spokesperson in a role playing simulation of a county planning commission meeting.

Addresses Guidelines for STS Education for Inner City Youth #3.1 which states to "select instructional activities that help students understand that they are interdependent members of an urban society and that their personal and group choices have important environmental effects on the urban ecosystem.

Lesson Plan #18. The teacher presents instruction on five categories of citizenship actions: persuasion, consumerism, legal, physical, and political action on the fourth day at Level IV. A quiz is presented following the instruction to determine if students can accurately classify examples from each of the categories.

Addresses Guidelines for STS Education for Inner City Youth #3.3 which states to "demonstrate how individuals with an understanding of science, technology, and their impact on society, can make a positive contribution to the urban environment through careers and community involvement", #4.2 which states to "encourage students to describe their thinking processes in reaching decisions on STS with a view toward improving their higher order thinking skills".
and #4.4 which states to "promote for students the realization that they are unique individuals with personal resources and their personal contributions on STS issues are important for all", and is linked to S-STS goal 7.

Lesson Plan #19. The fifth day at Level IV is designed to provide students an opportunity to identify alternative action plans toward which the STS issue might be resolved, and identify the consequences associated with each action. The students are permitted to work individually or in a group to develop their plan(s). The action plan has to be one in which the students feel they are able and willing to execute.

Addresses Guidelines for STS Education for Inner City Youth #5.2 which states to "foster development of problem-solving and written and oral communication skills in relation to STS issues...".

Lesson Plan #20. On the last day at Level IV, the students each make a presentation on the action plan(s) that they intend to implement. In two weeks, the effectiveness of the action plans will be evaluated by the students and revisions will be made where necessary.

EXAMPLE II

On Drugs: An STS Issue

Drug abuse has become a major concern among Americans. In recent surveys of urban youth and urban teachers, drug abuse consistently ranks as one of the top five issues facing students. This STS unit provides an example of one approach to examining this issue and designing actions students can take to help reduce drug use in their school.

The instruction provided to the students in this STS unit addresses the four goal levels cited above: Level I, the STS Foundations Level; Level II, the STS Issue Awareness Level; Level III, the STS Investigation Level; and Level IV, the STS Action Skills Development Level. The STS unit is designed to be delivered over a period of 20 school days (assuming one 45 minute period per day).

The instruction at Level I, the STS Foundations Level and Level II, the STS Issue Awareness Level would be the same as described in Example 1 since those activities are generic in nature. Therefore, the first three class periods of the unit would address the STS Foundations and the next three class periods would address the STS Issue Awareness Level.

Level III, STS Issue Investigations

For Level III, the STS Issue Investigation Level, eight class periods (unit days seven through fourteen) are needed for students to: 1) design and conduct natural and social science investigations, 2) collect and analyze data, and 3) make inferences, draw conclusions and make recommendations concerning illicit drug use in their community.

Lesson Plan #7 The teacher begins the first day at Goal Level III by asking the students what illicit drugs they think are common in their school. A list is generated on the board in a column titled "DRUGS". In a second column titled "SOURCE", the students are asked the geographical source of each of the drugs listed (i.e. cocaine from Brazil, marijuana from Columbia, LSD from California etc.) Some drugs may have several sources while students may not know where others come from.

In a third column titled "PATH", the students are asked to describe how the drugs get from the source to their school (i.e., coca leaves might be carried by mule from the

Margin Notes:

Addresses Guidelines for STS Education for Inner City Youth #1.2 which states to "begin with STS issues perceived relevant by the students and then include additional issues viewed relevant by teachers and experts, and #4.1 which states to "assist students to utilize knowledge and experiences of urban living to identify community STS issues".

mountains, processed into cocaine, then loaded on planes and flown to the U.S. where it is transported by cars or trucks to their community). The students then list in the fourth column titled "BUCKS" where users of these drugs might get their money to buy drugs.

The students are then asked to reflect on the activity. The development of these columns will help identify the scope and nature of the drug issue and set the stage for the investigations.

Addresses Guidelines for STS Education for Inner City Youth #2.1 which states to "provide learners with sufficient knowledge of ... the interactions between science, technology, and society to enable them to make informed decisions on STS issues" and #3.2 which states to "foster an understanding that all technologies have costs and benefits ..." and is linked to S-STS goals 1, 2, and 5.

Lesson Plan #8. On the second day at Level III, the teacher presents the columns developed on the previous day and asks the students how science, technology, and society may have fostered the development of the drug problem in the community. The students are divided into small groups for this activity. Designer drugs, "crack", and "angel dust" are example responses of how science has affected drug abuse. Medical technologies such as hypodermic needles as well as transportation technologies (i.e., planes, automobiles etc.) have also affected drug use. At this point, the teacher develops the notion that all technologies have costs and benefits.

Social values and beliefs have greatly impacted the drug issue. With the tacher's guidiance, the students will explore the many values and beliefs that have affected drug abuse. After the students have had 30 minutes to discuss the effects of science, technology and society on the drug issue, a spokes person from each group presents the groups findings.

Addresses Guidelines for STS Education for Inner City Youth #2.2 which states to "emphasize the use of scientific process skills that can be applied within the context of STS issues and in students' daily lives", and #2.3 which states to "encourage students to undertake hands-on scientific investigations that relate directly to their day-to-day experiences in their personal environments and is linked to S-STS goal 8.

Lesson Plan #9. The third day at Level III is designed to instruct the students on how to develop a survey. The term is introduced and developed by the teacher. Next, a survey is designed by the class to determine the extent of advertisements on television that promote over-the-counter drugs. The survey would include the number of commercials per hour, the products advertised, the number of commercials promoting over-the-counter drugs, and the percent of commercials that advertise drugs.

The survey would then be conducted by all members of the class that evening during their regular TV viewing times. Prior to leaving class, the students would make predictions what the total number of commercials/hour and the percent of commercials that are related to drugs.

Lesson Plan #10. The results of the survey are collected, interpreted, and conclusions are drawn by the class on the fourth day at Level III. Further discussions of the effects of science, technology, and society are conducted. Conclusions and recommendations are presented by students based upon their findings.

Addresses Guidelines for STS Education for Inner City Youth #2.2 which states to "emphasize the use of scientific process skills that can be applied within the context of STS issues and in students' daily lives", and is linked to S-STS goal 8.

Lesson Plan #11. On the fifth day at Level III, the drug issue and its relation to science, technology, and society is reviewed by the teacher. Next, a lesson on the structure and function of the nervous system is presented. Since this lesson is common in most science texts, the details will not be presented here.

Lesson Plan #12. A psychiatrist or psychologist (preferably an ethnic minority professional) would be invited to speak to the class on the sixth day at Level III. The psychological affects of using the drugs which the students identified as common in their school (lesson plan #7) would be the focus of the presentation. The guest speaker would also discuss career opportunities in his/her area. Ample time would be allotted for questions by the students.

Addresses Guidelines for STS Education for Inner City Youth #5.1 which states to interweave instructional activities which explore career opportunities that rely on science and technology backgrounds, especially within the urban environment".

Lesson Plans #13 & 14. On the seventh and eighth days of investigations, the students set up lab activities to learn about osmosis and diffusion respectively. The students work in small groups on both days. They record their observations and then present them in a large group setting. The implications of these activities are related to drug use.

Addresses that portion of the Guidelines for STS Education for Inner City Youth in #2.1 which states "provide learners with sufficient knowledge of concepts in the natural sciences...".

Addresses Guidelines for STS Education for Inner City Youth #5.1 which states to interweave instructional activities which explore career opportunities that rely on science and technology backgrounds, especially within the urban environment".

Addresses Guidelines for STS Education for Inner City Youth #3.3 which states to "demonstrate how individuals with an understanding of science, technology, and their impact on society, can make a positive contribution to the urban environment through careers and community involvement" and #4.4 which states to "promote for students the realization that they are unique individuals with personal resources and their personal contributions on STS issues are important for all" and is linked to S-STS goals 3, 4, and 7.

Addresses Guidelines for STS Education for Inner City Youth #4.2 which states to "promote the understanding that STS issues are perceived differently by individuals based upon their different backgrounds, values, experiences, and knowledge. #5.2 which states to "foster development of problem-solving and written and oral communication skills in relation to STS issues...", and is linked to S-STS goal 5.

Lesson Plan #15. A physician/pathologist (preferably an ethnic minority professional) would be invited to speak to the class on the ninth day at Level III. The doctor would discuss the physiological affects of using the drugs which the students identified as common in their school (lesson plan #7). Diseases associated with drug use would also be presented. The guest speaker would also discuss career opportunities in his/her area. Ample time would be allotted for questions by the students.

Level IV, STS Action Skills Development

The final five days of the STS unit are directed at Level IV, the STS Action Skills Development Level. These class periods concentrate on providing students with the skills necessary to take action on STS issues, individually or in groups.

Lesson Plan #16. The first day of instruction at Level IV is designed to have students identify alternative ends toward which the drug issue could be resolved, and examine the pros and cons associated with each end. The teacher begins this activity by noting that problems do not solve themselves, and to solve a problem, people must be willing to put forth time and energy. The students are then asked what they think they could do to help reduce the the amount of illicit drugs used by students in their school. After several alternative ends are identified, task forces of three to four students each are assigned to research and report on one of the alternative ends.

Lesson Plan #17. The following day is spent concluding the research and developing reports addressing the consequences of each of the alternative ends identified. A presentation is made near the end of the class period by each group on their assigned alternative end. The students individually identify what end he/she thinks is most desirable and supports his/her choice. The teacher asks why all the students did not pick the same alternative end since they each received the same information in class. Personal differences are then discussed.

Addresses Guidelines for STS Education for Inner City Youth #4.2 which states to "encourage students to describe their thinking processes in reaching decisions on STS with a view toward improving their higher order thinking skills".

Addresses Guidelines for STS Education for Inner City Youth #3.3 which states to "demonstrate how individuals with an understanding of science, technology, and their impact on society, can make a positive contribution to the urban environment through careers and community involvement", #4.2 which states to "encourage students to describe their thinking processes in reaching decisions on STS with a view toward improving their higher order thinking skills".
and #4.4 which states to "promote for students the realization that they are unique individuals with personal resources and their personal contributions on STS issues are important for all", and is linked to S-STS goal 7.

Addresses Guidelines for STS Education for Inner City Youth #5.1 which states to interweave instructional activities which explore career opportunities that rely on science and technology backgrounds, especially within the urban environment" and #5.2 which states to "foster development of problem-solving and written and oral communication skills in relation to STS issues...".

Lesson Plan #18. The teacher presents instruction on five categories of citizenship actions: persuasion, consumerism, legal, physical, and political action on the fourth day at Level IV. The students are asked to identify which category(ies) would be most effective in obtaining the alternative end they have identified and to justify their choice(s).

Lesson Plan #19. The fifth day at Level IV is designed to provide students an opportunity to identify alternative action plans toward which the drug issue might be resolved, and identify the consequences associated with each action. The students are permitted to work individually or in a group to develop their plan(s). The action plan has to be one in which the students feel they are able and willing to execute.

Lesson Plan #20. On the last day at Level IV, the students each make a presentation on the action plan(s) that they intend to implement. A special panel of professionals in the are of drug abuse are invited to attend their presentations. Members of the panel might include a social worker, volunteers from MADD and the Just Say No Foundation, a policeman(woman), and an elected official (legislator). Following the presentations, each panel member would briefly describe his/her career and how it relates to preventing drug abuse.

BIBLIOGRAPHY

Harms, N., and Yager, R. (ed.) (1981). What research says to the science teacher, Volume III. National Science Teachers Association, Washington, D.C.

Hines, J. (1984). An analysis and synthesis of research on responsible environmental behavior. Doctoral dissertation, Southern Illinios University, Carbondale, Il.

Hungerford, H.R., Peyton, R.B., and Wilke, R.J. (1980). Goals for Curriculum development in environmental education. The Journal of Environmental Education, 41 (4), 42-47.

Klingler, G. (1980). The effect of an instructional sequence on the environmental action skills of a sample of Southern Illinios eighth graders. Unpublished master's research report, Southern Illinios University at Carbondale.

National Commission on Excellence in Education (1983). A nation at risk: the imperative for education reform, U.S. Department of Education. Washington D.C.: NCE.

National Science Board (1983). Commission on Precollege Education in Mathematics, Science and Technology. Educating Americans for the 21st Century. Washington D.C.: NSB.

National Science Teachers Association. (1982). Science-technology-society: science education for the 1980s. Washington, D.C.: NSTA.

Ramsey, J., Hungerford, H. R. and Tomera, A. N. (1981). The effects of environmental action and environmental case study instruction on the overt environmental behavior of eigth grade students. The Journal of Environmental Education, 13 (1), 24-29.

Rubba, P. A. (In Press). Recommended competencies for STS education in grades 7-12. The High School Journal.

Rubba, P. A. and Wiesenmayer, R. L. (1985). A goal structure for precollege STS education: A proposal based upon recent literature in environmental education. Bulletin Science, Technology and Society, 5, (6), 573-580.

Sia, A. P., Hungerford, H. R., and Tomera, A. N. (1986). Selected predictors of responsible environmental behavior: An analysis. The Journal of Environmental Education, 17, (2), 31-40.